Return of the Moa

Is our Law ready for extinction that's not forever?

Megan Jane Neill

A dissertation submitted in partial fulfilment of the requirements of the Bachelor of Laws (Honours) at the University of Otago – Te Whare Wananga o Otago

November 2013

Acknowledgements

To my supervisor, Associate Professor Colin Gavaghan, for his perseverance and support

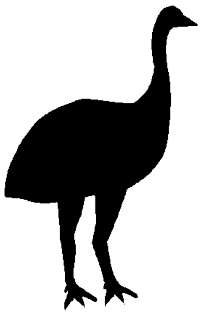
To Nicola Wheen, for practical advice and guidance

To Diane Bellamy, for telling me what I needed to hear

and to Ma, Pa, Fred and Pooh, for you know what.

No moa, no moa
In old Ao-tea-roa
Can't get 'em
They've et 'em
They've gone and there ain't no moa!

- Anon



We're not playing God.
We're coming to terms with our own powers,
as well as the unexpected results of our actions.

- Carl Zimmer

Contents

Introduction

Advances in technology mean the fantasy of bringing back extinct species is no longer science fiction. While the technology needs greater development and reconstructing ancient DNA requires what seem to be incredible feats of both puzzle-assembling skills and luck, the combination of research, technology and planning to achieve this, popularly termed 'de-extinction', is no longer to be dismissed.

Recognising that the Hazardous Substances and New Organisms Act 1996 (the HSNO Act) is the main legal hurdle to potential developers of de-extinct species in New Zealand, this paper identifies the considerations which would face the Environmental Protection Authority[1] (EPA) as the legislative gatekeeper, were an application for approval of a de-extinction project be put before them. It considers proposed de-extinctions of the moa, huia and kakapo (hypothetically extinct) in order to explore the implications of using the genetic resources of indigenous species for de-extinction in New Zealand. This exploration highlights the key requirements, being consultation with Māori and the provision of sufficient information, for a proposed developer in preparing an application. It also identifies the primary areas of importance for the EPA in their task of application evaluation.

The challenges resulting from the availability of de-extinction technology, are: public acceptance of using genetic modification for de-extinction; the categorisation of indigenous de-extinct species as 'new organisms' in law; the creation of a new legal category for de-extinct indigenous species; how much importance Māori beliefs should be afforded; and the impact on international markets from the release of genetically modified material. These matters are all relevant to this inquiry.

The principal affected New Zealand parties outside of the applicant and the EPA are Māori, primary producers, conservationists, international marketers and the general public. The interests of each of these parties are recognised in the legislation governing the EPA's mandate with regard to the introduction of new organisms. These matters are considered primarily in the light of risks, costs and benefits identified by information supplied by the applicant, submissions and consultation.

Genetic modification (GM) generates emotional responses that tend to polarise views. The potential economic, spiritual and social benefits of de-extinction will challenge those strong proponents of conservation and strong opponents of GM. While this paper does not explore their views, it does consider the issues central to this debate.

[1] In referring to the decision-making power under the HSNO Act, the 'Authority' is either the Environmental Risk Management Authority (prior to 2011) or the Environmental Protection Authority (post 2011).

Chapter 1: De-Extinction in the New Zealand Context

1.1 A brief history of New Zealand's unique biodiversity and extinctions

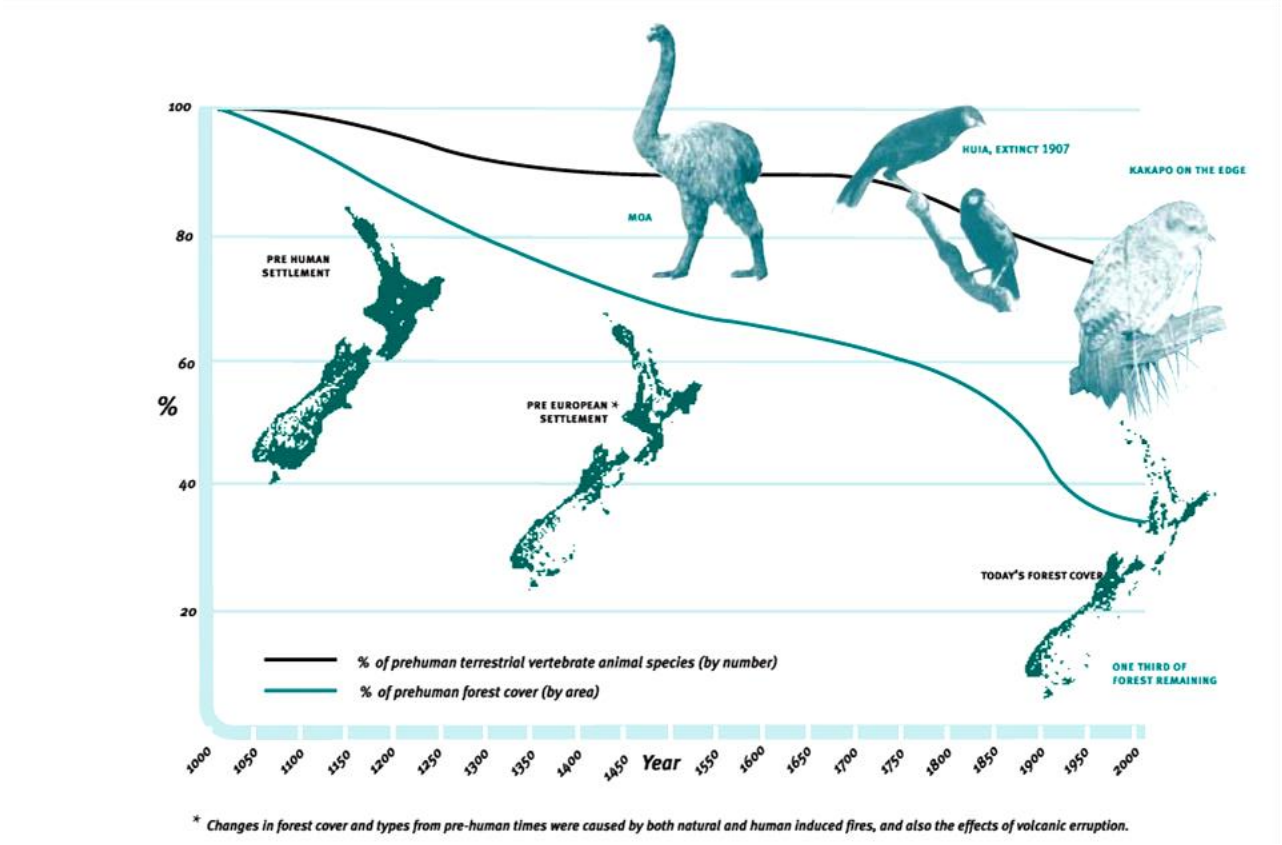
The land mass we know as 'New Zealand' separated from the southern super continent Gondwanaland roughly 82 million years ago[2] after the formation of a rift that became the Tasman Sea[3]. The closest continental land mass of Australia has been separated by close to 2,000km for an estimated 55 million years[4]. Consequently New Zealand's diverse biota is often compared with other isolated Pacific islands to which the low levels of migration allow existing species to spread and diversify, especially after extinction events[5]. However, as New Zealand has continental rather than volcanic or oceanic origins, its plant and animal lineages are far more ancient, such as ratites, tuatara and the frog species *Leiopelma*[6], which in many cases did not survive elsewhere. Species radiation also occurred differently in New Zealand due to repeated submersions, glaciations and a temperate (and sometimes subantarctic) climate[7] which formed New Zealand's unique, highly heterogeneous environments with distinctive ecosystems[8]. Species diversified to fill niches elsewhere occupied by terrestrial mammals, or large predatory reptiles or snakes, and the eccentric evolution of its flora and fauna has resulted in a very high percentage of endemic species. We have gigantism in insects such as weta and snails, flightless birds including the world's only flightless parrot (the kakapo), and dinosaur-like lizards[9]. In terms of fauna, as a result of evolution without any mammalian predators or competitors many species, especially birds, lost a number of their predator escape responses and a number became partially or fully ground-dwelling, leaving them susceptible to the introduction of predators[10] (human and the animals they brought with them) and land clearance[11] which also decimated

[2] Roger A. Cooper and Philip R. Millener "The New Zealand Biota: Historical Background and New Research" (1993) 8 Trends in Ecology & Evolution 429.
[3] Kara J. Matthews and others "A Global-Scale Plate Reorganization Event at 105–100 Ma" (2012) 355–356 Earth and Planetary Science Letters 283.
[4] Matt McGlone "Evolution of plants and animals - How did they arrive?" Te Ara - the Encyclopedia of New Zealand (2012) <http://www.TeAra.govt.nz/en/evolution-of-plants-and-animals/page-2>
[5] Cooper and Millener, "The New Zealand Biota: Historical Background and New Research." (1993) 8 Trends in Ecology & Evolution 429 at 431 and 432.
[6] This species is unique in that it lays eggs which hatch into adult frogs rather than tadpoles.
[7] Charles H. Daugherty and others "Mega-Island or Micro-Continent? New Zealand and Its Fauna" (1993) 8 Trends in Ecology & Evolution 437. at 437.
[8] For example, the braided rivers of eastern South Island, northern North Island Kauri forest, and the central North Island geothermal ecosystems, see Hugh Logan "Gondwana Invaded: An Address on Distinctive Features of Managing Indigenous Biodiversity in Protected Areas in New Zealand" (2001) 31 Journal of the Royal Society of New Zealand 813.
[9] Cooper and Millener, "The New Zealand Biota: Historical Background and New Research." (check this for use as reference here) *Check out* Daugherty CH et al, "Taxonomic and Conservation Review of the NZ Herpetofauna" *NZ Journal of Zoology*.
[10] Richard P. Duncan and Tim M. Blackburn "Extinction and Endemism in the New Zealand Avifauna" (2004) 13 Global Ecology and Biogeography.
[11] Richard Holdaway "Extinctions - New Zealand extinctions since human arrival" Te Ara - the Encyclopedia of New Zealand (2012) <http://www.TeAra.govt.nz/en/extinctions/page-4>

endemic species of flora. This resulted in, "[a] once continuous range of unique ecosystems has been turned into a patchwork of isolated fragments"[12].

As shown by Figure 1, human habitation caused the loss of a huge number of unique New Zealand species in a very short space of time, in fact, "nothing since the extinction of the dinosaurs (65 million years ago) compares with the decline in indigenous biodiversity in New Zealand over the last century." [13] An estimated 40% of New Zealand birds became extinct after human arrival.[14] Today, active management is required to conserve the 1000 of our known animal, plant, and fungi species considered 'threatened'.[15]

Figure 1. The trend of indigenous biodiversity decline over the last millennium (1000 - 2000 AD)*



**Estimated trends of indigenous biodiversity loss (as reflected in species extinctions and loss of forest ecosystems) in New Zealand since 1000AD sourced from New Zealand's Biodiversity Strategy 2000.*

The result is that New Zealand is one of the "world's biological prizes" for both its unique evolution and the record it gives us of the destruction wreaked by human habitation[16]. Yet the New Zealand Biodiversity strategy identified that we have only managed to slow, not halt the decline of indigenous flora and fauna[17].

[12] Department of Conservation *The New Zealand Biodiversity Strategy* (Ref. ME616 Ministry for the Environment February 2000) at 6
[13] Ministry for the Environment, *The New Zealand Biodiversity Strategy*, (Department of Conservation 2000) at 4
[14] Ian Newton *Population Limitation in Birds*, Population Limitation in Birds (ed., Academic Press, London, 1998). at 449.
[15] Logan, "Gondwana Invaded: An Address on Distinctive Features of Managing Indigenous Biodiversity in Protected Areas in New Zealand."

Current global, social and economic imperatives include the protection and enhancement of biodiversity. New Zealand's response in protecting its international image as 'clean and green' and a 'responsible steward for its environment and biodiversity'[18] is the establishment of management programmes[19] which intervene for endangered species. The adoption of new technology when available has improved the outcomes of these programmes[20]. Advances in technology now provide the opportunity for a quantum leap in the conservation of species from preservation to restoration of extinct species.

1.2 The Technology

De-extinction has been acknowledged as a real, scientific proposition[21] that scientists, conservationists and bioethicists are taking seriously enough to start shifting the frame of questions from 'is this technology possible' to considering its implementation. For example, 'which animals are good candidates', 'is this an ethical thing to do', and cost-benefit analyses of re-introducing these animals into the modern world[22]. The accepted premise is that this technology will be realised, though there is no consensus as to when it might be fully viable.

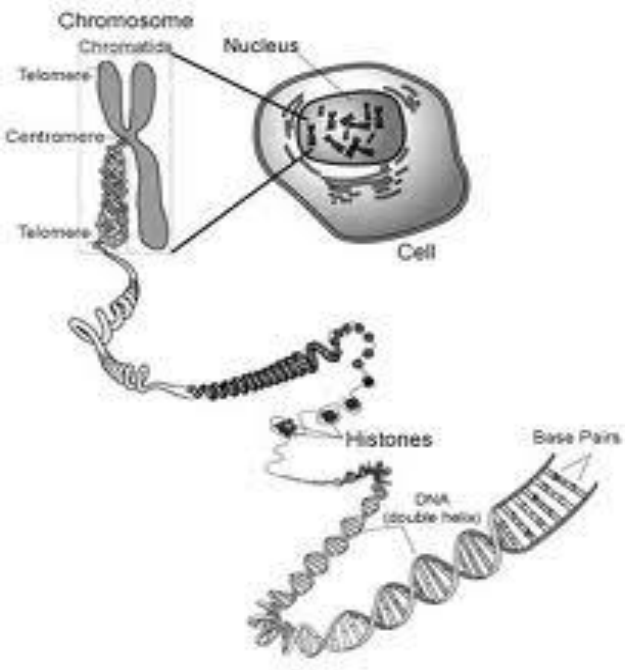


Figure 2. Depiction of the structural relationship between DNA and a cell

There is an important distinction in current technology capabilities between resurrecting species which are recently extinct with frozen tissue (entire cells) available and attempting to resurrect those with only bones or stuffed specimens remaining. DNA can still be extracted from bone or other remains, but its degradation over time means piecing together the fragments is likened to reassembling shredded dictionary without a template. This DNA is referred to as 'ancient DNA'.

---

[16] Jared Diamond "New Zealand as an Archipelago: An International Perspective" in DoC (ed), *Ecological Restoration of New Zealand's Islands* (1990) 3.
[17] Environment, "The New Zealand Biodiversity Strategy." at 7
[18] ibid at 10
[19] These range from intensive relocation and breeding programmes to the establishment of reserves and predator-fenced parks.
[20] For example electronic tracking devices used for kiwi recovery programmes.
[21] Carl Zimmer "(Some) EXTINCTION IS (not necessarily) FOREVER" (presentation to Ted^{X} DeExtinction Conference, Washington D.C., March 2013)
[22] These are examples of questions posed by presenters at the Ted^{X} DeExtinction Conference, Washington, D.C., March 2013.

There are seven very general steps to de-extinction of ancient species [23]:

1) Getting the genome sequence;[24]
2) Organising genome sequence into correct chromosomal structure;[25]
3) Putting those chromosomes into a nucleus;
4) Getting nucleus into a cell capable of forming an embryo;
5) Implanting embryo into a surrogate mother for gestation;
6) Have the surrogate carry the foetus to term; and
7) Introduce the species successfully into the environment.

Each of these steps present significant barriers to de-extinction of species without intact cells, and current technology cannot perform these steps start to finish. However, steps 1 – 3 may be able to be abridged by reverse engineering the genome of a closely related species to give it the characteristics of the extinct species. Steps 4 to 6 are the basic formula for the cloning technology that created Dolly the sheep[26] and is now a common procedure for mammalian species.

Cloning, more technically known as 'somatic cell nuclear transfer' (SCNT)[27], is a technique in which the nucleus is extracted from an ordinary ('somatic') cell[28], then inserted into another animal's enucleated egg cell. That recombined embryo is then implanted into another animal for gestation and birth, resulting (hopefully) in an animal genetically identical to the one from which the nucleus was taken. A range of animals have been cloned this way and the techniques are now commercially available[29]. Scientists have successfully used tissue which had been frozen for sixteen years, cloning a mouse which was then healthy enough to reproduce[30].

The SCNT technique was used to de-extinct an animal for the first (and so far only) time in 2009 when a Pyrenean Ibex, or 'bucardo', was born to a Spanish ibex–goat hybrid surrogate[31], nine years after the bucardo's official extinction. Skin cells previously taken and cultured were inserted into enucleated eggs of domestic goats but the single bucardo carried to term died minutes after birth. Despite confidence that this

[23] Noted by ancient DNA specialist Beth Shapiro, Assistant Professor Department of Ecology & Evolutionary Biology, University of California, Santa Cruz in "Ancient DNA: What It Is and What Could It Be" (presentation to Ted[X] DeExtinction Conference, Washington, D.C., March 2013)
[24] This means the finding, sequencing and ordering of a complete copy of all the nuclear DNA of an organism. It should be noted that this hasn't been accomplished for any vertebrate species to date, including humans, although it has reached 99%.
[25] Chromosomes are the super-structures into which our DNA is tightly coiled. For example, humans have a genome of roughly three billion DNA base pairs organised into 23 chromosomes.
[26] Born in 1996, Dolly was the first mammal to be cloned from an adult somatic cell, see K. H. S. Campbell and others "Sheep Cloned by Nuclear Transfer from a Cultured Cell Line" (1996) 380 Nature 64.
[27] There are other types of cloning, but this is currently the most commonly used for live animals.
[28] A skin cell for example.
[29] Roughly 26 types of animals have been cloned using somatic cell nuclear transfer.
[30] See Hiroshi Ohta and others "The Birth of Mice from Testicular Spermatozoa Retrieved from Frozen Testicular Sections" (2008) 78 Biology of Reproduction 807.
[31] See J. Folch and others "First Birth of an Animal from an Extinct Subspecies (Capra Pyrenaica Pyrenaica) by Cloning" (2009) 71 Theriogenology 1026. This was the only foetus to be carried to term from 57 embryos transferred to surrogates.

result could be improved on the project has been abandoned for lack of funding. The first clone of an endangered species, the gaur (an exotic breed of Asian cattle), was born to a domestic cow surrogate in 2001, dying less than 48 hours after birth[32]. However, more success was had with the second endangered species cloned, the banteng, born in 2003 and transferred to the San Diego Zoo. In Korea in 2008, several clones of endangered gray wolves were born from somatic cells collected post-mortem[33].

In Australia, the Lazarus Project has been working towards de-extinction of the gastric-brooding frog[34], using tissue fortuitously frozen before the species 1980's extinction. The results of the research have not been officially published, but it was reportedly successful so far as the recombinant cells dividing into early embryo formation[35].

The proposed de-extinction of the woolly mammoth is another project receiving media attention[36] and is a case demonstrating the exponential increase in difficulty arising when intact cells are unavailable. As soon as an organism dies, its DNA begins to decay[37]. The conditions in which an organism dies can dramatically alter the preservation of DNA, but it has an average half life of 521 years[38]. A team of scientists are reportedly pursuing the woolly mammoth project, having sequenced recovered mammoth DNA amounting to an estimated 50% of the mammoth genome[39]. Some still hope that the mammoth project will be 'fast-tracked' if an intact cell is found in remains still buried in the northern permafrost. Failing this, the proposal considers using Asian elephant DNA to plug the gaps.

This hybridisation is another developing technique proposed for de-extinction. The genome of a close relative is used as the backbone for the extinct species' chromosomal and cellular structure. Genes for particular traits are then spliced in to form a genetic hybrid which is physiologically, and ideally behaviourally like the extinct species. While still incredibly challenging[40], this is simpler than attempting to rebuild a genome and cellular structure from scratch. The project underway in America to restore the passenger pigeon[41] proposes its de-extinction through hybridisation with the band-tailed pigeon[42]. This project's plans

[32] Gretchen Vogel "Cloned Gaur a Short-Lived Success" (2001) 291 Science 409.
[33] See HJ Oh and others "Cloning Endangered Gray Wolves (Canis Lupus) from Somatic Cells Collected Postmortem" (2008) 70 Theriogenology 638.
[34] (Latin name), A species of frog with the unique trait of ingesting its eggs, its stomach becoming a womb for the gestation period before giving birth by vomiting its young back out through its mouth. – give reference for this statement
[35] University of New South Wales "Scientists produce cloned embryo of extinct frog" (press release, 15 March 2013) <https://newsroom.unsw.edu.au/news/science/scientists-produce-cloned-embryos-extinct-frog>. The cells divided almost as far as gastrulation (at which point the cells of an embryo turn inwards and being differentiation into the three germ layers.
[36] Woolly mammoths are estimated to have died out roughly 10,000 years ago.
[37] Morten E Allentoft and others "The Half-Life of DNA in Bone: Measuring Decay Kinetics in 158 Dated Fossils" (2012) 279 Proceedings of the Royal Society B: Biological Sciences 4724.
[38] Ibid.
[39] See Webb Miller and others "Sequencing the Nuclear Genome of the Extinct Woolly Mammoth" (2008) 456 Nature 387.
[40] Few traits are the result of a single gene, most involve interactions between several gene products and pathways. These genes and interactions would need to be located, mapped and tested before getting close enough to call something a 'passenger pigeon' as opposed to anything else.
[41] The last living passenger pigeon died in 1914. Originally in flocks too large to count, commercial hunting slaughtered them in the hundreds of thousands and is considered the major reason for their extinction.

already go beyond genetics, including proposals for the retraining of passenger pigeon behavioural traits such as flocking and migration patterns via the use of trained homing pigeons dyed to look like passenger pigeons.

Technology continues to emerge which addresses barriers to de-extinction. For example, the current need another species' egg cell[43] to form an embryo which, among other issues, has epigenetic effects on the de-extinct species' nuclear DNA. Epigenetic effects are still largely unknown but have an important role in signalling which parts of the DNA are switched on and off, directing the early stages of cell replication and embryo development[44]. Studies indicate the potential avoidance of this issue by inducing cells into a pluripotent state[45,46] and demonstrating it is possible to cause these induced pluripotent stem cells (iPSCs) to form gametes (sperm or egg cells) under particular conditions[47].

In New Zealand, native species of megafauna are almost exclusively of the feathered variety[48] so de-extinctions here would need to address the bird egg factor, as avian egg cells[49] make-up means the SCNT technique is not viable for birds. Instead, a second generational approach has been recently developed and proved successful in producing transgenic chickens[50]. Germ cells, (precursor cells to sperm and ova) differentiate early in the embryonic development of birds and migrate to later form the ovaries or testes. This new approach inserts modified germ cells or cells from another species at the stage of germ cell migration. When the embryo matures and is mated to a chicken carrying similarly modified germ cells, and offspring produced from the combination of those modified germ cells will be genetically modified or of another species[51]. One study demonstrated this technique's implications for surrogacy by inserting chicken germ cells into a duck embryo, thus a duck was able to produce chicken sperm and father a purebred chicken[52]. In another study chickens were used as surrogates for the endangered bustard[53].

---

[42] Ben Novak "How to Bring Passenger Pigeons All the Way Back" (presented to Ted^{x} DeExtinction Conference, Washington, D.C., March 2013)
[43] This contains residual DNA from the host cell species.
[44] J. C. Kiefer "Epigenetics in Development" (2007) 236 Dev Dyn 1144.
[45] That is a state from which a cell is able to differentiate into more specific types of cells such as muscle, skin and nerve cells.
[46] See Michael J. Boland and others "Adult Mice Generated from Induced Pluripotent Stem Cells" (2009) 461 Nature 91.
[47] Katsuhiko Hayashi and others "Offspring from Oocytes Derived from in Vitro Primordial Germ Cell–Like Cells in Mice" (2012) 338 Science. Also see Lin Yao and others "Application of Ips in Assisted Reproductive Technology: Sperm from Somatic Cells?" (2011) 7 Stem Cell Reviews.
[48] On some definitions of megafauna can also include bats and lizards.
[49] For instance, bird eggs include a yolk which is a single, complex cell.
[50] J. Macdonald and others "Efficient Genetic Modification and Germ-Line Transmission of Primordial Germ Cells Using Piggybac and Tol2 Transposons" (2012) 109 Proceedings of the National Academy of Sciences of the United States of America 1466.
[51] Proposals to accelerate this process include the development of a strain of chickens that do not produce their own germ cells so only implanted germ cells will be available.
[52] Julie-Anne Barnes, "After Dolly the Sheep... Duck Is Dad to a Chicken [Scot Region]," *Daily Mail*, 2013 Mar 18 2013.
[53] Chunhai Liu and others "Houbara Bustard Hatching in Surrogate Chicken Albumen and Eggshell" (2013) 6 Avian Biology Research 239.

Technology for de-extinction is not ready for extinct animals to be developed and released in the next few years as it is all still highly experimental and expensive[54], though recent research has made significant progress toward removing the technological barriers to de-extinction. As the viability of the technology increases, so does the environmental, economic and social interest and concern regarding the restoration of extinct species for conservation and commercial motivations. These, along with spiritual and ethical arguments raise barriers to the technology's implementation. All of these factors contribute to the complexity of the Authority's task of applying the HSNO Act.

[54] At the TedX De-extinction conference (see supra note 42), the speaker on the passenger pigeon project, Ben Novak gave an estimate of 20-30 years for the revival of the passenger pigeon species.

Chapter 2: Application of Hazardous Substances and New Organisms Act 1996

The HSNO Act is New Zealand law's main vehicle for governing scientific research and development that uses controlled substances, or introduced or genetically modified organisms. If an organism[55] is a 'new organism', approval from the EPA is necessary in order to import, develop, field test or release that organism in New Zealand[56]. The conducting of any of these activities without approval from the EPA amounts to offences under s 109(1) of the Act.

2.1 Hypothetical De-Extinction Scenarios

This paper will be referring to three hypothetical scenarios to exemplify different levels of application and considerations under the Act. As the inquiry changes according to the type of approval applied for, the hypothesised intention of each project will include: development; field-testing and observation in containment; breeding in containment (such as a zoo enclosure); release into a controlled environment; then full release into the 'wild'. In reality, projects would progress through each stage over an extended period of time, though before such a project is undertaken, technology may have developed to shorten the time from development to testing.

The hypothetical scenarios are:

1) Recreating a currently threatened indigenous species, the kakapo, which has become extinct, using the cloning method for birds noted at [1.2]. I.e. the insertion of preserved germ cells into chicken embryos which are then matured and mated to produce kakapo offspring.
2) The recreation of huia or moa using a hybridised approach with a related species for the backbone of the DNA and cellular structure.
3) The recreation of moa or huia from piecing together ancient DNA – assuming that at some time in the future technology will allow synthesis of a genome and cellular structures without hybridisation of a related species in the process.

[55] The base definition of 'organism' is section 2 is a broad, inclusive definition, the intention apparently being to capture all manner of life aside from human beings.
[56] Hazardous Substances and New Organisms Act 1996, s 25(1),

2.2 De-Extinct Species as New Organisms

For any of these three scenarios to fall within the HSNO Act's purview, a de-extinct bird must qualify as a 'new organism' under s 2A[57]. The most relevant category of seven listed in this section appears to be paragraph (d), which deems a 'genetically modified organism' to be a new organism. This fit is reinforced by the definition of 'genetically modified organism' in s 2 which prima facie has a very broad application, encompassing all organisms in which genes have been modified by '*in vitro* techniques' directly including progeny which have inherited modified genes. While the HSNO Act doesn't define '*in vitro* techniques', it generally means having 'taken place outside of a living organism' (i.e. in a test tube or petri-dish)[58], which would necessarily occur for all of the proposed techniques employed for de-extinction.

Despite the broadness of the definition, genetic modification won't apply to de-extinct species if regulations expressly provide otherwise[59]. The possible exclusion lies in regulation 3 of the Hazardous Substances and New Organisms (Organisms Not Genetically Modified) Regulations 1998 ('Non-GM Regulations') which lists techniques considered *not* to give rise to genetically modified organisms. Included at regulation 3(1)(b) are 'organisms that are regenerated from organs, tissues, or cell culture'. Despite the assertion by commentators that the Non-GM Regulations are mostly aimed at the propagation of plants, the EPA's website states that, 'regeneration' can refer directly to the cloning of animals, evidenced by the website's theoretical example, "cloning a dinosaur from the marrow of dinosaur bones". An animal created by 'regeneration' then only requires approval if "the animal from which the biological material is *sourced* is classed as a new organism"[60], for example, if the species applied to be cloned will be an imported species or one eradicated from New Zealand. Therefore, the regeneration of an organism which is not classed as or sourced from a 'new organism' under other categories of s 2A, will not require approval under the HSNO Act. An organism may also be deemed no longer 'new' following an Order in Council or once released without controls[61].

To determine whether a de-extinct animal will not be a new organism, the first question is whether the term 'regeneration' as per the Non-GM Regulations can extend to the techniques in the hypothetical scenarios. The most likely scenario to avoid classification is the cloning of the kakapo, as this would insert whole cells (taken from organs or tissue) into a chicken embryo without *in vitro* modification on a DNA level. This differs from standard mammalian cloning via SCNT in that the cell isn't implanted into a surrogate's uterus, but the embryo of another species, arguably 'genetically modifying' the chicken embryo in the process. However,

[57] Proceeding on the assumption that via whichever method or state of creation/development they will be 'organisms' under s 2, unless referring to the pure isolation of DNA fragments which cannot self-replicate. HSNO approval would not be required for this work unless the end result of the 'project' was the result of a replicating cell which could be classed as an 'organism'.
[58] As per Oxford Dictionary 2013 <http://www.oxforddictionaries.com/definition/english/in-vitro>
[59] Hazardous Substances and New Organisms Act 1996, s 2
[60] Emphasis added. New Zealand Environmental Protection Authority "Regenerate new organisms in containment" <http://www.epa.govt.nz/new-organisms/find-application-form/all-applications/Pages/regenerate-no-application.aspx>
[61] Regulations may be made under s140 of the Hazardous Substances and New Organisms Act 1996 prescribing organisms 'not new', and under s 2A(2)(b)(i), an organism as the same taxonomic classification as one release approval under s 35 or s 38.

this is unlikely to be a critical difference given the similarity to the mammalian process of nuclear transfer to the enucleated egg cell of another animal in forming the embryo. The principle of cloning to replicate an animal from a cellular or nuclear level without manipulation of the DNA is retained in the avian version of cloning. As the kakapo germ cell is untouched in regards to its DNA, it is unlikely the derived chicken embryo will be deemed a new organism.

The decayed state of moa and huia DNA mean a 'simple' translocation of cells is not possible. For 'regeneration' to apply, it would need to be argued in broad sense, looking to the end result rather than the technological steps in the process. The Non-GM Regulations considers genetic modification to exclude organisms which are regenerated from 'organs, tissues or cell cultures'. The common denominator of these terms is the replication from nothing smaller than an intact cell, arguably excluding individual cellular components. The reference on the EPA's website to the regeneration of the dinosaur likewise could be said to be referring to a scenario in which an intact cell is found[62]. The end result in the second and third hypotheticals may still come from the regeneration of cells in cultures or grown tissue, however both require many more steps in order to reach the stage of viable, replicable cell cultures. The DNA required to regenerate a moa or huia, whether from hybridisation of DNA from a related species or synthesised and patched together from numerous sequence templates would necessarily involve the *in vitro* manipulation of individual genes or 'genetic material' to get it into a viable, replicating, cellular form. Given the surrounding context in the regulation and the derogation this would cause to the definition of 'genetic modification', I don't believe the use of the term 'regeneration' was intended to extend to this kind of manipulation. Thus projects which intended to reconstruct replicating cells of moa or huia would almost certainly be classed as 'new organisms' by virtue of being 'genetically modified organisms' under s2A(d). The use of the cloning technique at later stages would still require approval unless and until they are declared as 'not new' or approved for release without controls. In other words, an organism (being a replicable cell or higher level) which is created by 'regeneration' will not be a 'new organism' (unless sourced from an otherwise 'new organism'), but one which is created by, or has inherited material altered by genetic modification, will be.

The second step in determining if a de-extinct animal will escape being a 'new organism, requires it to be 'regenerated' from the material of a species that does not qualify as a 'new organism' under one of the categories of s 2A (or having been declared a new organism under s 26(1)). To be classed as a 'new organism', the source species would need to fall under s 2A(1)(a) or (e), requiring that it was either 'not present in New Zealand immediately before 1998', or was 'eradicated' from New Zealand, respectively. Interestingly the EPA appears to have assumed that the interpretation of s 2A(1)(a) includes species which were extinct prior to 29 July 1998[63]. On this interpretation the kakapo, having become (hypothetically)

[62] Note only fossilised remains of dinosaurs have ever been found, the DNA having long been degraded.
[63] On the Environmental Protection Authority's website, "An organism that became extinct before July 29 1998" is included on a list entitled, 'a new organism is defined as'. <http://www.epa.govt.nz/new-organisms/about/Pages/what-is-a-no.aspx,>

extinct post 1998 would not be 'new', but the moa and huia would be. However, this interpretation is arguable as it hinges on the interpretation of 'present' as meaning 'living'. A species does not cease to be classed as a 'species' simply because it is extinct, and the organic material which constituted these species remains 'present' in New Zealand. An issue with this interpretation is that it could be extended to the preserved material of non-indigenous species imported in to New Zealand prior to 29 July 1998, almost certainly a result which would bypass controls intended to fulfil the purpose of the Act in protection of environmental and human health and safety. One further argument for the huia's exclusion from the definition is in the interpretation of 'immediately' given that the last (confirmed) sighting of a huia was in 1907, in comparison to the moa's many centuries of extinction.

The use of paragraph (e) to capture these species is less likely as it hinges on the use of the word 'eradicated'. The explanation on the EPA's website inserts the word 'deliberately' and interprets 'eradication' as being the "result of a specified eradication programme with a stated goal or purpose of eliminating the organism from New Zealand", indicating that Parliament's intent was for this paragraph to be aimed at organisms considered to be pests and requires an element of intent to their removal from New Zealand.

On balance, a purposive approach makes it likely that moa and huia recreated with current technology would be 'new organisms' under the HSNO Act, requiring approval from the EPA for their development, field-testing or release. However, if kakapo or another currently living indigenous species were to become extinct (or if the technology were to be employed to aid a breeding programme), paragraph's (e) or (d) would need to be relied upon to trigger the application of the HSNO Act processes to a project for their de-extinction. It should be noted that regardless of the application of the HSNO Act, approvals by the Department of Conservation where the source of genetic material is 'wildlife' under the Wildlife Act 1953[64], and by an Animal Ethics Committee - while holding a Code of Ethical Conduct registration will be required for de-extinction projects.

The difficulties demonstrated in attempting to fit de-extinct species within this definition could give rise to the argument that a new category is appropriate for organisms considered to be 'de-extinct indigenous species', or derived from the remains of extinct indigenous genetic material.

Biotechnological advances and understandings of its application to de-extinction will continue, making its scope and form unpredictable. The broad definitions in the HSNO Act, especially "genetically modified organism", mean its application to all current forms and those of the foreseeable future involving recombinant DNA is likely with the continued use of *in vitro* techniques. However, greater knowledge, experience and familiarity may lead to more modifications being included in the Non-GM regulations, or as

[64] See Wildlife Act 1953, s 2

'low-risk genetic modifications' and thus subject to a rapid assessment process as provided for in the Hazardous Substances and New Organisms (Low-Risk Genetic Modification) Regulations 2003 ('Low-Risk Regulations').

2.3 Low-Risk Genetic Modification and Rapid Assessment

Rapid assessment can be undertaken for a development in containment application if the technology and host organisms used are 'low-risk' according to the definition in the Low-Risk Regulations[65]. The kakapo-cloning scenario is one which could easily qualify as it does not involve recombinant DNA[66] and given the defined nature of the organisms used. The other scenarios are far less likely to qualify as 'low-risk' given the likelihood of the use of recombinant DNA, but more information on the technology may indicate that in the absence of the use of viral vectors these also have the potential to be 'low-risk' modifications.

Rapid assessments are undertaken by the delegated authority of an Institutional Biological Safety Committee (IBSC) in the research centre or University proposing the application. An IBSC's deliberation is concerned mainly with biological safety. They undertake the same considerations as the Authority's[67] standard assessment and are required to show that consultation with Māori has taken place[68]. However, rapid assessment applications are not publically notified, thereby eliminating the third party submission process, and will probably not involve a hearing[69]. Public notification is an important step[70] for the making of public submissions[71] and is required for all applications bar those for development in containment, which the Authority can elect to also notify the public of if they consider there is '...likely to be significant public interest...'[72]. Public hearings can be required by the Authority or requested by the applicant or a submitter[73].

[65] Hazardous Substances and New Organisms Act 1996, ss 42A, 42B and 42C. The Hazardous Substances and New Organisms (Low-Risk Genetic Modification) Regulations 2003 are created under s41 of the HSNO Act. Rapid assessment is not available for field-testing or release applications of GMOs.
[66] The Hazardous Substances and New Organisms (Low-Risk Genetic Modification) Regulations 2003 appear focused on the development and use of viral vectors and increased pathogenicity of genetic elements through genetic modification. The kakapo-chicken cloning scenario would almost certainly be a category 1 host organism under s7(1), using a category A genetic modification under s5(1) and almost certainly not use of techniques in the Schedule thus being classed as 'low-risk'.
[67] Described in this paper at [3.1].
[68] Nicola Wheen "Research with Animals" J Dawson & N Peart (ed) *The Law of Research: A Guide*(University of Otago Press, Dunedin, 2003) Chapter 6
[69] Nicola Wheen "Research with Animals" J Dawson & N Peart (ed) *The Law of Research: A Guide*(University of Otago Press, Dunedin, 2003) Chapter 6
[70] A number of commentators have remarked on the lack of opportunity for the incorporation of public views in the decision process under HSNO even including the step of public notification.
[71] Hazardous Substances and New Organisms Act 1996, s 54.
[72] Hazardous Substances and New Organisms Act 1996, s 53.
[73] Ibid, s 60.

Despite any of the scenarios qualifying for rapid assessment as 'low-risk', the decision may still be referred back to the Authority through the refusal of an application by the IBSC[74] or the exercise of the Ministerial call-in powers.

2.4 Ministerial call-in powers

Section 68 of the HSNO Act allows the Minister to "call in" an application if the Minister considers the application will have any of the significant effects on: the economy; the environment; international relations; health; spirituality; or an area the Authority lacks sufficient knowledge or expertise[75]. If the Minister calls-in an application, the Authority will be notified and must begin a public inquiry[76]. The Minister can also appoint anyone with relevant knowledge to sit with and exercise the power of the Authority[77]. A report of the Authority's recommendations based on that inquiry is given to the Minister, whose decision will have the same effect as a decision by the Authority[78]. It is difficult to make any kind of judgment on whether the Minister would be likely to exercise the call-in powers over an application of a de-extinction nature. However, the significant effects identified later in this piece would no doubt legitimise the exercise of this power. The likelihood would increase according to a perceived lack of consideration by the Authority, extensive consultation with Māori, potentially collective public pressure, and certainly if a rapid rather than full assessment were attempted to be undertaken.

[74] Refusal of an application by an IBSC does not prevent Authority from accepting for assessment.
[75] Prior to 2003 amendments to the HSNO Act, the effects considered did not include cultural, spiritual or ethical effects.
[76] Hazardous Substances and New Organisms Act 1996, s 71
[77] Ibid. s 70
[78] Ibid. ss 72 and 73

Chapter 3: Roles and Considerations of the Authority

3.1 Overview of Authority's Role and Process of Decision-Making

The role of the EPA in assessing applications is created by a combination of powers, mandatory inquiries, standards, principles and purpose under the HSNO Act. The decision elements EPA must address in this evaluation are established in the Hazardous Substances and New Organisms (Methodology) Order 1998 ('the Methodology')[79]. The EPA is required to identify all potential 'effects' in a 'risk, cost, benefit and other impacts' analysis and estimate the significance of these effects, based on the probability of their occurrence and magnitude - assessed on the assumption of proposed and potential additional controls being in place[80]. Following the decision of *Mothers Against Genetic Engineering v Minister for the Environment* ('*MaDGE*') it is clear that the Authority, while required to consider ethical issues directly relevant to an application, must weigh these alongside other considerations. They are not expected to "embark on a consideration of the public policy issues involved in fundamental ethical obligations to genetic engineering generally"[81].

While the Authority is bound to adhere to Methodology, it is in substance rather than expressly cross-referencing paragraphs that is required[82]. This is practical given the number of considerations listed in the Methodology which partially or fully overlap with the Act's decision criteria. Being an error of law, a failure to apply the Methodology is basis for an appeal to the High Court, and is one of the only ways in which an appeal of a decision can be made[83].

The requirements of the EPA's task change according to the type of application being considered. Section 45 of the HSNO Act is the central provision for decisions on applications to import new organisms into containment, field-test, or develop new organisms in containment. The Authority can approve these types of applications if:

- they are made for a s 39 purpose;
- after considering the matters in ss43 and 44 (which relate to ability of organism to escape and become established) – which must also be considered for applications to import into containment or field-test;
- '...the beneficial effects of having the organism in containment outweigh the adverse effects of the organism and any inseparable organism should the organism escape'[84]; and

[79] Regulations created in accordance with section 9(1) of the HSNO Act.
[80] Reference decision making pathway
[81] *Mothers Against Genetic Engineering v Minister for the Environment* HC Auckland, CIV 2003-404-673, 7 July 2003 at [176].
[82] *Bleakley v Environmental Risk Management Authority [2001] 3 NZLR 213 (HC)*
[83] Requiring a point of law for appeal - Hazardous Substances and New Organisms Act 1996, s126
[84] reference

- the Authority is satisfied the organism can in fact be contained.[85]

This test under s 45(1)(a)(ii)is essentially, "a balancing of beneficial effects of having an organism in containment against the adverse effects of the organism and any inseparable organism"[86]. Specifically for applications to field-test GMOs in containment, the Authority must also consider the '...safety and any ecological effects of the field-test; and ... any alternative method of achieving the research objectives that is as [or more] effective ... as the field-test'[87].

In addition to the consideration of the ability of the organism to establish itself, and the ease with which it could be eradicated, should it escape, applications to import new organisms for release, or to release new organisms (either with or without controls) are set an extra bar of minimum requirements under s 36, intended for environmental protection and human health and safety. Provided these standards are met, the Authority can approve a release application if the positive effects of the organism outweigh its negative effects[88].

3.2 Key Points in Decision Pathway

As an appendix to its decisions the Authority includes a 'Decision Pathway' and explanatory notes which outline the specific approach the Authority takes to applications. The following are the key points along that pathway[89]:

1) Sufficient information available?
2) Application for proper purpose?
3) Scope of the organism identifiable?
4) Organism able to form a self-sustaining population and/or easily eradicated?
5) Alternative research methods available?
6) Organism able to escape containment (for containment applications)?
7) Non-negligible adverse ('risks, costs and other impacts') and beneficial effects[90] identified and evaluated against range of impact areas and approach to risk[91] identified in the Methodology, including, in the case of release, meeting the minimum standard requirements.
8) Any international obligations?

[85] Reference this or rearrange – Nicola's Law of Research Chapter.
[86] Madge case at [21].
[87] s44A, Hazardous Substances and New Organisms Act 1996
[88] Clause 27(1) and (2), ibid.
[89] This is based on the amalgamation of decision pathways from ERMA decision appendices to encompass both containment and release considerations.
[90] Note that the consideration of adverse and beneficial effects on the relationship of Maori is normally considered at step 6) will be discussed in section/chapter (*) of this paper.
[91] As per clauses 12, 22(1), 25(1) and 33

The degree of challenge for EPA in applying the legislation increases with uncertainty of technology and potential flow on effects, as shown in following (Table 1).

Table 1. Magnitude of concern relative to technology proposed and application type

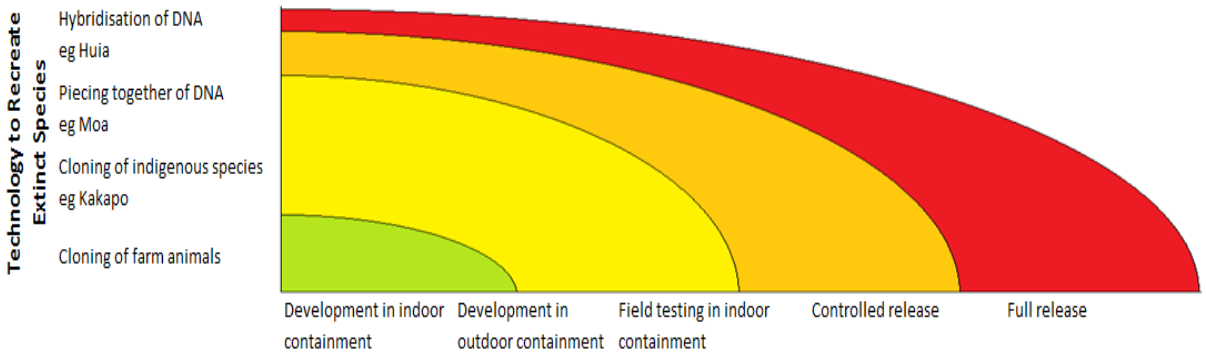


Table 1, moving from green to red, indicates the increased probability and magnitude with which the Authority is likely to regard adverse effects relative to the technology proposed and the type of application which also has increased considerations in the legislation.

3.2.1 Sufficient Information

Section 40(2) lists the information required to be supplied by an applicant in an approval application[92] and includes the information required by the Methodology and the approval form[93]. The Authority requires information which is "sufficient and necessary"[94] to their task of assessing adverse and beneficial effects which granting an application may have. The Authority can refuse an application on the basis of a lack of information[95] or require an applicant to submit more information[96], or request reports from government agencies or other Authorities[97]. However, this does not preclude the Authority from accepting for consideration approvals which are generic in nature[98].The key determinants of this step appear to be:

- The type of approval that is being applied for – the greater the number and consequences of risks the more accurate information is necessary for appropriate assessment.
- The availability of information on risks associated with genetically modified organisms – it has been recognised that experimental research involving GMOs is inherently uncertain. The controls available

[92] These are reiterated in the Hazardous Substances and New Organisms (New Organisms Forms and Information Requirements) Regulations 1998.
[93] AgResearch Ltd v GE Free NZ in Food and the Environment Inc [2010] NZCA 89 at [18] as per O'Regan J.
[94] Methodology, cl 8
[95] For import or release or new organism with controls – s 38C. For development in containment lack of information can put the application outside the scope of s 40(2).
[96] Hazardous Substances and New Organisms Act 1996, s 52
[97] Ibid, s 58
[98] AgResearch Ltd v GE Free NZ in Food and the Environment Inc [2010] NZCA 89

for *containment* applications have been deemed enough to offset what risks have so far been identified, but the effect in regards to release applications has not been determined.

- Specificity of information an applicant provides on the technology they will use in their project and its previous documented use. It is difficult to judge what the EPA would consider as too vague.

The EPA has been previously criticised for accepting applications which arguably have not met all of the information requirements. However, given the emphasis put on containment standards in reducing risk and the increased concern in use of indigenous genetic material, the high-profile of a de-extinction application will mean an applicant will likely negotiate with the EPA as to what information is required prior to the application's formal submission.

3.2.2 Application for a 'proper purpose'?

'Proper purpose' is outlined in s 39 of the Act. Those listed are extremely broad and effectively procedural. For instance, a proper purpose can be simply 'the development of a new organism', the 'field testing [of] any new organism' and the 'public display of an organism'[99], without a consideration of the purpose of the development of that organism. Despite its heading, this section is not an invitation for the Authority to engage in ethical determination of 'proper'[100].

3.2.3 Identification of scope of organism

While the Authority is able to restrict the scope of an organism by the imposition of controls, this identification is important for the public's ability to provide submissions on an application[101] and for a thorough assessment of the effects. While the first de-extinction scenario presents easily defined organisms, the second and third projects have greater complexity, involving more than either an interspecies cellular transfer or a single identified gene insertion.

Organisms can be identified as generally as the level of genus, yet as this classification is a human construct it can vary according to the technique used. The possible categorisation techniques include the use of genetic markers[102], or phenotypic features. When dealing with genetic manipulation on the level required by scenario's second and third, it would be possible to manipulate these classifications by inclusion of genetic markers or physiological features.

[99] Hazardous Substances and New Organisms Act 1996ss 39(1)(a),(b) and (e) respectively.
[100] The Authority has noted this in several decisions, see for example ERMA200223 Decision Document. Also *Mothers Against Genetic Engineering v Minister for the Environment* HC Auckland, CIV 2003-404-673, 7 July 2003 at [176].
[101] GE Free NZ in Food and Environment Inc v Environmental Risk Management Authority [2011] NZRMA 45
[102] i.e. identifying and testing for a particular gene or mutation.

3.2.4 Ability to Establish Self-Sustaining Population and Ease of Eradication

The ability of an organism to establish a self-sustaining population and the ease with which that population might be erased is a factor which is repeated in several places in the Methodology and Act and is considered regardless of the type of application applied for regarding a new organism[103]. However, for success of the long-term goals of de-extinction, it is imperative that the population of the recreated species have the ability to procreate without human intervention. This flows against the general purpose and set-up of the legislation designed to maximise control of new organism populations. The EPA is not required by the legislation to consider the likelihood of success of a project, though this could be a factor in assessing both the potential benefits and animal welfare issues.

In regards to development, cultured cell-lines (assumedly non-pathogenic), all require human intervention and specialised growth conditions (for example, temperature, media and CO_2) to survive. Thus in the event of an escape of any cell-lines established for production and testing for DNA would be unlikely to survive to form a self-sustaining population. There should be no issue here if techniques are used whose risk profiles have been documented.

In the event that other animals which may be used for the testing of traits (of which there are species present in New Zealand) were to escape, the relevant consideration[104] is whether those animals could breed with non-modified animals and pass on the genetically modified traits. It will depend upon the specifics of the introduced trait as to whether it would give the individual any selective advantage. In this situation a usual control is to have all animals tagged in order to be identified and returned. GPS technology is now an effective option for this control.

With regard to the de-extinct birds ability to create a self-sustaining population will be severely limited for a long time. In the event of an escape by an individual (assuming it is breeding capable) no others of its species will exist for it to mate with. If the species is a hybrid, there is still much less chance that it would survive to breed than that of a farm animal housed in the same region as its species[105]. Further, breed-able 'close relatives' are practically non-existent for the moa, huia and kakapo. It is more likely that these animals would need intensive assisted breeding programmes such as those conducted by DOC for other endangered species like the huia's relatives, the saddleback and kokako. It is also likely that a species whose DNA has been

[103] Hazardous Substances and New Organisms Act 1996, s 35 for rapid risk assessments, s 37 for the determination of applications to import or release, s 38C for importing or releasing new organisms with controls, clause 10 of the Methodology also repeats it at paragraphs (e) and (f).
[104] As noted by the in the Evaluation and Review Report: a supporting document to decision ERMA200223 .
[105] AgResearch has been granted numerous approvals for indoor and outdoor containment development of transgenic cattle, sheep and goats in a facility on the same site as other trials involving the same species with the proviso that they are not adjacent.

pieced back together will not have the same instincts as its extinct predecessor species, and not have the behaviours to survive without a slow introductory process over generations[106].

Even when the addition of flight is considered for the huia, the ability of a single, or even few birds to form a self-sustaining population is highly improbable given their main method of feeding is ground-based and their habitat severely reduced through human occupation[107].

3.2.5 Alternative Research Methods

Whether alternative research methods are available is an additional matter for consideration under s44A for applications to develop or field test GMOs in containment which is not a 'containment structure'. The Authority must take into account any alternative method of 'achieving the research objective' that 'has fewer adverse effects' on human health and safety, the environment and 'any effects resulting from the transfer of any genetic elements to other organisms in or around the development or field test', than the proposed development or field test.

The key here is whether the 'research objective' can be achieved in a way which would have fewer significant (or non-negligent) risks associated with it. For example, if the objective of the development of huia or moa was stated as studying their physiological and behavioural traits, arguably there is still much that could be learnt from the examination of their remains. However, if the objective is to establish and reintroduce breeding populations of these birds, then there are many fewer available alternatives – unless perhaps detail scale changes to vectors or other methods used for the genetic development could be exchanged. Attempts to de-extinct species such as the aurochs have been made through selective breeding, but this can never reach the same level of restoration as vast majority of the original gene pool has disappeared.

3.2.6 Ability of Organism to Escape

It would be understood through pre-application negotiations that the eventual goal of a de-extinction project is reintroduction to the wild. However, the uncertainty surrounding the technology will likely mean a progression through the application stages is necessary in order to study effects and allay concerns regarding unknown or unpredictable consequences.

The legislation requires that the ability of an organism to escape be considered for field test applications and the Decision Pathway notes that it is 'good practice' for containment applications. The Authority also refers to this ability and likelihood of escape in several of their containment decisions as justification for assessing a number effects at a low likelihood. The method which the Authority employs here is to identify all potential

[106] See TedX presentation by Ben Novak (supra note 42) See generally William Wright *Born That Way : Genes, Behavior, Personality* (Hoboken, Taylor and Francis, 2013)
[107] See Higgins, Peter Jeffrey; Peter, John M; Cowling, SJ, eds. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 7: Boatbill to Starlings, Part A: Boatbill to Larks* (Melbourne Oxford University Press 2006).

escape routes at the level of DNA through to the organisms involved in the activity and assess the likelihood of each route. This assessment is unlikely to be approached differently for a de-extinction application, unless any additional evidence is given specific to the technology and the ability of elements involved to escape containment. The accommodation of winged rather than land-bound animals is unlikely to pose any additional issues if the containment structure is approved.

3.2.7 Adverse and Beneficial Effects

Clauses 26 and 27 of the Methodology allow the Authority to approve an application for a new organism when satisfied it will not cause any s 36 effects, the 'evident benefits' outweigh the adverse effects and negligible risks are posed to the environment and human health and safety by the organism. If the risks are not negligible or the benefits not 'evident' the Authority must take into account 'the extent to which the risks and costs associated with that [organism] outweigh the costs'. The considerations are weighted in the Act and Methodology giving greater strength to the principles which require the EPA to 'recognise and provide for' as opposed to the s 6 requirement to 'take into account'[108].

The Authority refers to the Methodology terminology of risks and costs as 'adverse effects' and the benefits as 'beneficial effects', an approach I will adopt in the assessment of effects likely to be identified and considered by the EPA. The EPA's determines the degree of negligibility of adverse effects based on their probability and magnitude[109]. It should be noted that risks are assessed on the basis of establishing controls.

For dealing with uncertainty the EPA must refer to clauses 29 – 32 of the Methodology. Having accepted that there is inevitably uncertainty with GM the EPA has so far relied on controls and containment standards in place for containment applications to assess the likelihood of adverse effects. The EPA is required to take a precautionary approach to their decision-making, especially where there is 'scientific and technical uncertainty' of effects[110]. This principle shifts the burden of proof on to the applicant to show the activity is not harmful. However, with regard to international conservation, the precautionary approach circumvents the 'lack of full scientific certainty' when implementing 'cost-effective measures to prevent environmental degradation'[111]. De-extinction may arguably be such a measure for the future, putting these formulations at odds.

a) The Environment

Given its broad nature and repetition of aspects in the Methodology, this area is likely to contain numerous issues for the EPA to consider. This task, which is geared by the legislation towards precaution, protection and control of alien species, is ill-fitted for the consideration of the three scenarios with their potential conservation contribution as 'native' species.

[108] *Bleakley v Environmental Risk Management Authority* [2001] 3 NZLR 213 (HC) at [254]
[109] Methodology, cl 12.
[110] Hazardous Substances and New Organisms Act 1996, s 7
[111] Rio Declaration on Environment and Development, Principle 15

The key clauses of the Methodology require the Authority to do the following in regards to the environment when considering an application:

- *recognise* risks, costs, benefits, and other impacts associated with the substance or organism in an application which relate to the safeguarding of the life-supporting capacity of air, water, soil, and ecosystems, and provide for this principle (clause 9(a)); and
- *take into account* all risks, costs, benefits and other impacts associated with the organism which relate to:
  (i) The sustainability of all native and valued introduced flora and fauna; and
  (ii) The intrinsic value of ecosystems (Clause 9(c)); and
- *evaluate* the information provided on the risks, costs, benefits, and any other impacts which relate to :
  (a) The significant displacement of any native species within its natural habitat
  (b) The significant deterioration of natural habitats
  (c) The significant adverse effects on New Zealand's inherent genetic diversity
  (d) Ability to cause disease, be parasitic, or become a vector for ...animal or plant disease ... (Clause 10).

i) Adverse Effects

The Authority will consider the potential adverse effects on a case by case basis, however they are likely to use the absence of recorded adverse effects over the history of genetic modification and in similar projects as evidence. In the case of release (controlled or full) there are have been no applications to date for the release of GMOs so the Authority's approach can only be speculated on. However, as referred to by Table 1 the number and potential magnitude of effects considered is likely to increase dramatically the less controlled the environment can be. Further, the EPA will have the additional, minimal standards to consider for a release application.

With regard to containment, examples of similar potential adverse effects considered by the Authority on previous occasions for development and field-testing include the:

(i) deterioration of the natural environment by escape of in vitro modified genetic material (DNA);
(ii) contamination of ecosystems by toxins produced by GMOs or through consumption of animal products;
(iii) deterioration of animal health resulting from the creation of new reservoir for animal disease;
(iv) deterioration of animal health resulting from the creation of new pathogenic viruses;
(v) unanticipated effects of GM; and
(vi) contamination of non-GM products.

These considerations were all assessed relative to the controls which would be in place – i.e. a MAF (now MPI) approved containment structure with controlled access. Thus in assessing the significance of these effects, the EPA concluded each time that the likelihood given the containment nature of the application rendered them negligible – or negligible enough to be outweighed by the benefits. An increased likelihood or magnitude of effect may be considered in the de-extinction scenarios for the following reasons:

a) The ability of the organism to escape due to being able to fly (huia) or being released by a third party because of its resemblance to a native species may increase the likelihood of the effects.
b) The use of DNA from indigenous species and especially in the situation where it is in combination with another species DNA may increase the potential for the de-extinct species to become a reservoir or vector for diseases which could affect populations of other native bird species. It may be interesting to note whether the concern of the EPA is greater here than with the potential of cattle, sheep and goats potential to affect the agricultural sector.
c) The likelihood of all these effects will no doubt increase with the lessening of controls in an environment.

With regard to a development application, the creation of a GMO in any of the scenarios will be unlikely to raise too many concerns which cannot be assessed as negligible with the addition of controls. However, the key to the consideration will be how specific an applicant can be as to what technology will be used and whether any new information has come to light regarding horizontal gene transfer and its effect in the environment. The EPA is far more likely to grant an application which uses techniques that have been documented so as to give evidence of likely effects or the safety of those techniques. Uncertainty will have a role to play here, and even more obviously in an application for release. There is potentially a fine line between no adverse effects having occurred to date and a lack of sufficient information to determine risk, as the former is no supposed to be evidence of the latter[112]. However, the 'unanticipated effects of GM' are unlikely to prevent a development application from proceeding if no previous effects have been documented.

Other concerns raised in regards to de-extinction include potentially drawing attention away from current conservation projects and principles and creating unrealistic public expectations of extinction no longer being terminal. However, this effect is highly speculative and difficult to measure, thus would likely be considered non-negligible by the EPA. The diversion of funding from current conservation efforts is not a sound argument unless there is government funding involved. The potential application of this technology to the assisted breeding of currently endangered species means the benefit is likely to outweigh these additional, uncertain effects.

[112] *GE Free NZ in Food and Environment Inc v Environmental Risk Management Authority* HC Wellington CIV 2007-485-1340 12 May 2008

ii) Minimum standards

The EPA must refuse an application for release if the new organism is likely to have any of the environmental effects identified in s 36. The Authority can consider these same concerns for other applications due to the Methodology's legislative overlap with regard to escape effects though these will be tempered by the likelihood of escape.

The minimum standards of s 36 are:

(a) cause any significant displacement of any native species within its natural habitat

This effect is arguably predicated on a new organism not being considered a 'native species' itself. It is possible to consider a de-extinct species as either a native species being restored to a habitat in which it previously had a niche or, as an alien species entering a new world order in which it may outcompete native species against predators for reduced resources. For the kakapo this is unlikely to present an issue given their well-documented habits and current state of existence requiring assistance of breeding programmes and an established niche. Evidence is also available though much more limited, regarding the habitat, diet and behaviours of both moa and huia. This may not be of much concern however as their reintroduction would take place over such an extended period of time that there would be opportunity to observe them.

A related question is how much competition is considered 'significant'. One study noted that feral deer have spread so quickly in filling the niche left by the moa's extinction being similar grazers. However, as deer are not 'native', and are pests under the Wild Animal Control Act 1977, any competition in that regard is unlikely to be considered an adverse effect.

(b) cause any significant deterioration of natural habitats

It should be possible to estimate from current studies and observation prior to release the kind of effect the birds will have on natural habitats. In fact, some studies indicate that both the moa and huia had important roles in their ecosystems as seed dispersers. The GM effects remain unknown.

(c) cause any significant adverse effect to New Zealand's inherent genetic diversity

This may be possible in a superficial sense of New Zealand's perceived identity as being 'GE free', or arguably if the genetic material of two or more native species were hybridised. However, the use of the 'inherent' legitimises an argument that de-extinct species are already a part of that genetic diversity and their release would instead support New Zealand's genetic diversity.

(d) cause disease, be parasitic, or become a vector for human, animal, or plant disease, (unless that's its purpose).

Assumedly, the species would be developed and re-established in a disease free environment within New Zealand and therefore won't introduce anything new. However, concern here is more likely to be their vulnerability to current diseases and the possibility of becoming vectors for those.

iii) Beneficial Effects

The effects which the EPA may consider relevant include: development of technology used to aid currently struggling species; demonstrable evidence of the role played by the species in the ecosystem, for example as seed distributers, possibly increasing the sustainability of other native flora, fauna and ecosystems[113]; and awareness of the technology may draw attention to the need for protection of natural habitats, prompting people to become more active in the protection and reestablishment of native flora and fauna.

b) Human Health and Safety

The EPA has spent considerable time in previous decisions evaluating the potential pathways, likelihood and magnitude of risk in this area. In terms of applications for release, one of the minimum standards under s 36(e) requires that the Authority decline the application if the new organism is "likely to ... cause disease, be parasitic, or become a vector for human...disease".

While these minimum standards are only employed by the Act for applications for release (after importation or from containment), the Methodology also brings it into play as a consideration for all types of applications under:

- Clause 9(a): to the extent that impact on environment and ecosystems affects life-supporting capacity then could be called human health and safety; and
- Clause 9(c)(iii): taking into account risks, costs, benefits, and other impacts associated with the new organism which relate to 'public health'; and
- Clause 10: the Authority is required to evaluate the information provided on risks, costs, benefits and other impacts which relate to the (c)significant adverse effects on human health and safety, and (g) the ability to cause disease, be parasitic, or become a vector for human ... disease.

i) Adverse Effects

Those considered by the EPA in previous decisions have been mostly detail-orientated and based on the information provided by the applicant, including drawing conclusions from the lack of previous mishaps with the type of technique used. Most noted are concerned with possible reactions of humans to the modifications such as the production of a new toxin, allergy or infection by reactivated retrovirus or any viral vector in use. However, considered in light of the controls and safety standards imposed on containment facilities, these were held to be of negligible concern given their low probability and

[113] A key principle under s 5(a), Hazardous Substances and New Organisms Act 1996

minimal magnitude. This will hold true of de-extinction applications if the vectors and techniques used are ones which have been previously utilised in studies without mishap.

The scrutiny of this area in relation to an application for release would be much greater. These concerns can be broadly grouped into three categories:

a) Unknown cumulative effects of genetic modifications and gene transfer
b) Unpredictable behavioural traits which mean the birds might pose a physical danger to humans in contact with them
c) The immune system capabilities of the birds which might give them increased capacity (in comparison to other wildlife) to be a vector for disease to humans by the incidental incorporation of a genetic modification.

Much of the unknown surrounds these concerns. However, the release of a GMO is a huge psychological step for New Zealand and it would follow a long development and field-testing process designed to study the interaction between the de-extinct birds and their environment, including concerns for human health. Time enough for better information to gather information reducing the likelihood of a release application being refused on the grounds of uncertainty. Despite the uncertainty, most of these concerns are unlikely to prevent a development or field-test application for containment.

ii) Beneficial Effects

To be considered non-negligible there would likely need to be some direct link between the techniques used for the development of the birds and human health. For example the development of techniques that may be useful in treating human conditions such as the technique which reverses cells to stem cells, and stem cells to germ cells (see [1.2]). Other potential benefits included the spiritual and emotional response to seeing these species in the feather, and the 'provision' for the sustainment of a healthy ecosystem for the benefit of future generations[114] if the conservation potential of these species is realised.

c) Society and Community

The EPA has a reputation for considering scientific evidence of greater importance and less importance to other, harder to quantify values, rendering them more likely to be negligible[115]. Despite the inclusion of a variety of values in the Act and Methodology, some of these values cannot perhaps be quantified and so it will always be an exercise of judgement on the part of the EPA.

[114] Methodology, cl 9(b)(ii)
[115] See Nicola Wheen "Genetic Modification, Risk Assessment, and Maori belief under New Zealand's Hazardous Substances and New Organisms Act 1996" (2004) 8 APJEL.

The most direct reference to this area in the Methodology is under clause 9(b) (also s5(b)) which requires the Authority to

> recognise and provide for the principle of maintenance and enhancement of the capacity of people and communities to provide for –
>
> (i) Their own economic, social, and cultural wellbeing; and
>
> (ii) The reasonably foreseeable needs of future generations.

Generally speaking, the Authority has tended to address the specific concerns in submission made on applications rather than refer to this principle. However I will include in this section effects relating to this principle which may have been previously overlooked as well as those from decisions, as the consideration of release, whether conditional or fully heightens all aspects of concern for the Authority.

i) Adverse Effects

Assertions to the effect that an application would 'harm our way of life' by not fitting with our wider community values, cultural and national identity is hard to quantitatively measure without undertaking large scale surveys of the population. The Authority has considered[116] that applications to be conducted in containment would have little effect on the wider community – and "identified no likely pathway for this application to have any impact on the New Zealand way of life, and previous approvals have not had a noticeably negative effect on our cultural identity." The EPA also noted that there are a wide range of opinions in the community, and it is not their role to judge whose view is most correct[117]. Conditional or full release applications are likely to push the Authority to engage more in these types of concerns and attempt to quantify those views, though they are likely to continue to consider that containment applications pose little risk to the wider community. A concern may be posed of commercial exploitation of de-extinct species, especially if 'native'. This is at odds with legislation which is considers commercial aspects in terms of benefits[118], and more likely to be considered in reference to Māori concerns (see Chapter 4).

ii) Beneficial Effects

The EPA has placed great emphasis on benefits from research and development leading to increased knowledge and scientific capacity in past decisions, and especially in the case of containment decisions. Yet this blanket benefit is still open to being challenged.

iii) Animal Welfare

Part 2 of the HSNO Act gives the Authority capacity to consider animal welfare and related ethical issues under the principle in s 5(b) (see above section). However, the general approach appears to be

[116] See Decision Document of Application ERMA200223
[117] Ibid at [3.5.5]
[118] See clause 9(c)(v) of Methodology and s6 of the Act.

acknowledgement of the application of part 6 of the Animal Welfare Act 1999 ('AWA') which deals more specifically with ethical issues regarding the use of animals in research.

The AWA requires applicants to hold a Code of Ethical Conduct ('CEC') and gain approval from an Animal Ethics Committee ('AEC') for projects which use animals for "research, testing or teaching purposes[119]" ('RTT'). CEC's contain RTT policies and procedures, and identify the AEC appointed by the code holder and responsible for ensuring compliance with that CEC. AEC's can: approve or decline projects; set, review or revoke conditions for a project; and renew, suspend or revoke a project's approval[120]. Most institutions and research centres in New Zealand have CECs and AECs approved under the AWA already in place[121]. AEC's, researchers and research organisations are monitored by Ministry of Primary Industries[122] ('MPI') and are required to ensure animal welfare is a paramount consideration and the impact of the RTT is minimised[123]. The EPA appear to consider AECs the most appropriate vehicle for addressing animal welfare concerns raised in an application and will likely be satisfied there are no significant effects where an applicant has approval from and continued monitoring by an AEC.

With regard to the most common concern of birth defects, the EPA will likely only be concerned if the deformity rates are shown to be greater than those of cloning and are due to the genetic modification being specific to the application. Although the AEC can consider this regardless of what the cause is.

The AWA may not apply to a de-extinction project in some circumstances. If this is the case the EPA may well have to develop their considerations for animal welfare, including perhaps engaging in an ethics based discussion on the welfare of the recreated animals. For part 6 of the AWA to apply, the activity must involve an "animal" being subject to "manipulation"[124] which amounts to "research, testing or teaching"[125] for a "project"[126]. Based on the definitions of these terms, part 6 of the AWA may not apply in the following situations:

i) Development applications which stand alone as a 'project' where the research does not involve an 'animal', the definition in s 2(1) excluding any single cells, cell-lines or embryos, foeti or pre-hatched young in their first stage of development.

ii) Applications for field-testing, or more likely controlled release and release where any research or testing done on the birds does not amount to 'manipulation', by being capable

[119] Defined s 5 Animal Welfare Act 1999
[120] Animal Welfare Act 1999, s99
[121] For example, Otago University has a Animal Ethics Committee at each of its three campus sites.
[122] Previously Ministry of Agriculture and Forestry, merged with Ministry of Fisheries and New Zealand Food Safety Authority to form MPI in 2012.
[123] Catherine Dunckley and others "Research with Animals" J Dawson & N Peart (ed) *The Law of Research: A Guide*(University of Otago Press, Dunedin, 2003) Chapter 8.
[124] Defined Animal Welfare Act 1999, s 3
[125] Ibid, defined s 5
[126] Ibid, defined s 2

of being described as 'normal management practice', given that their 'type' is comparable to other endangered species[127]. Alternatively, if the birds are deemed as 'wildlife' under the Wildlife Act 1953, part 6 will not apply if the actions are in fulfilment of responsibilities or functions under the Conservation Act 1987 or associated Acts such as the Wildlife Act 1953.

This means that for applications for birds which have already been developed and are no longer being 'manipulated', the EPA will have a greater need for the consideration of animal welfare.

Several decisions reference the 'ERMA New Zealand Ethics Framework'[128], indicating that the ethical considerations it incorporates are drawn from the AWA[129]. That is to; '[minimise] any suffering of animals, including reducing the use of animals where possible'; 'refining experiments to ensure least harm or damage'; and 'replacing animal models by other models where possible'[130].

The non-application of the AWA may mean that the ethics of the entire project and end goal may be considered by the EPA at the outset (i.e. development). For example, in relation to de-extinction the ethics of attempting to de-extinct an animal whose habitat loss may mean it can only ever exist in a contained state such as a zoo. Thus the EPA may have the opportunity to consider the viability of the end goal of de-extinction projects – how possible it is to restore these birds in the wild with the state of their original environment. However this flies in the face of at least two things. The first is that the EPA, unlike an AEC, doesn't appear to have a mandate to consider the likelihood of success of a project. Secondly, the ability of a species to establish a self-sufficient population would usually be counted against it given the concern of being able to eradicate a species should it prove a pest.

d) Market Economy

Economic considerations receive strong weighting under the Act and Methodology, requiring the Authority to both 'take into account… economic and related benefits to be derived from an organism' , as well as recognise and provide for the principle of 'maintenance and enhancement of the capacity of people and communities to provide for their own… economic… wellbeing... and the reasonably foreseeable needs of future generations'. The potential adverse and beneficial effects in this area are mostly speculative, requiring qualitative risk analysis. Previous decisions have directed most attention to the use of genetic modification for foods which will ultimately be consumed by humans but the commercial farming of either huia or moa is highly improbable and therefore it is the secondary implications to international markets that are most relevant.

[127] Endangered species programmes likely excluded operating under the Conservation Act, see section 5(3) Animal Welfare Act 1999.
[128] yet I have been unable to locate this document on the website or through other sources so it may be that a new framework is under development with the EPA
[129] Application ERMA200223 Decision Document at [6.1.2]
[130] Application ERMA200223 Decision Document at [6.2.44]

i) Adverse Effects

New Zealand's two key markets and drivers of the national economy are the sale of primary produce and tourism which are promoted on our 'clean and green' branding. As part of tourism growth and primary product sales:

[i]ncreasingly, New Zealand's international reputation and trade opportunities will depend on our performance in maintaining a quality natural environment, of which biodiversity is a key element .

Wider consumer perception of GM as being contrary to this image creates the risk that these markets may be compromised by the release of GMOs in any form in New Zealand as market competitors are continually looking for the means to discredit New Zealand's brand. This concern stems from the perceived risk of GM material entering the human food chain, and while the Authority found that none of the research conducted in indoor and outdoor containment since the 1970's has 'led to any detectable deterioration of market perception of New Zealand's "clean green image"' this concern remains in relation to release applications.

The view that genetic modification is unnatural, and consequently that something which has been modified through 'nature' is inherently good, is at odds with the scientific basis of evolution and the on-going environmental modification from human activity. Humans release mass amounts of chemicals and resource consumption by-products into the environment which has had effects as significant as global warming. Therefore there is a disconnection between how the technology we use already affects the environment and our perception of genetic modification being used to do so. There is an emerging body of thought that genetic modification is likely to be our last and only resort for the saving of our environment in a more natural state.

In terms of de-extinction, the question becomes whether genetically modified species derived from native species in fact enhance New Zealand's 'clean and green' image rather than destroy it. If New Zealand were to set about restoring historical ecosystems in our country with the use of genetic modification, would this increase the value of our biodiversity and international standing in conservation and as a visitor's destination, or, is our biodiversity only inherently valuable because it comes from a source which we have believe we have made no visible modification to. If the de-extinction of indigenous species were to enhance our biodiversity, even given that the value of this has proven difficult to quantify , this could be added to the beneficial effects side of the equation.

The EPA commented that all of the major export markets – the US, EU, China, Japan, India, South America - engage in laboratory and outdoor experiments involving genetically modified organisms. However, these countries are not reliant on the same 'clean and green' branding adopted by New Zealand. Despite this, the assumption that the release of GMO's would undermine this image is one which requires more consideration.

ii) Beneficial Effects

The EPA has placed a lot of emphasis on the potential benefits to commercial agriculture industries through research based on genetically modified organisms. Development of de-extinction technology may produce commercially applicable side-benefits in the farming of domestic birds. However a recent review conducted by the McGuinness Institute on genetic modification in New Zealand over the last forty years indicates that despite millions of dollars invested in GM experiments, there was 'little benefit and significant economic risk' . How much of an effect this type of study will have on future committee decisions is uncertain but is likely to be considered given the mandate requiring to Committee to examine all relevant material.

e) International obligations

Section 6(f) of the HSNO Act and clause 9(c)(vi) require the Authority to take into account New Zealand's international obligations when determining [an] application. New Zealand is a signee to several international agreements with an impact on the HSNO Act. The applicant is required to consider whether these have implications for their application. Both the Convention on Biological Diversity and potentially the associated Cartagena Protocol are relevant. Many of the principles under the Convention on Biological Diversity illustrate the tension between biotechnology and conservation – the Convention attempts to reach a compromise between sustainable development, indigenous rights and the conservation of natural habitat. De-extinction is a potential bridge to these tensions as noted later in this piece.

Chapter 4: Taha Māori

4.1 Authority's Approach to Evaluating Māori Concerns

In assessing potentially significant effects on Māori capacities and relationships[131], the EPA is required to evaluate an application in accordance with clauses 9(b)(i) and 9(c)(iv) of the Methodology and ss 5(b), 6(d) and 8 of the Act. Clause 25(2) reinforces the need for the EPA to consider matters and values relating to Māori concerns when evidence in an application refers to relevant part 2 values. The EPA is assisted by a statutory Māori advisory group formed under the Environmental Protection Authority Act 2011[132], Nga Kaihautu, tasked with advising on Māori perspectives in matters of 'policy, process and decision-making'[133],

[131] Terminology used in s 5 and 6 of the Hazardous Substances and New Organisms Act, 1996.
[132] This Act disbanded the previous advisory group, Nga Kaihautu Tikanga Taiao established by the HSNO Act. However, on the website the current committee is still referred to by the same name.
[133] Environmental Protection Authority Act 2011, s 19 and current Terms of Reference (to be reviewed in 2014).

seeking to 'protect and uphold the integrity of tikanga and mātauranga Māori and to monitor [these ideologies] application by the EPA in undertaking its functions'[134].

Clause 9(b)(i) and s 5(b) directly overlap, requiring the Authority to 'recognise and provide for the principle of maintenance and enhancement of the capacity of people and communities to provide for their own economic, social and cultural well-being' which includes Māori in its reference to 'community' and 'cultural well-being'. Clause 9(c)(iv) and s 6(d) produce a lesser mandate, requiring the authority to *'take into account*... the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu[135], valued flora and fauna, and other taonga[136]". While not referred to in the Methodology, s 8 of the HSNO Act requires the Authority, and indeed all persons with decision-making powers under the Act, to 'take into account' Treaty of Waitangi principles.

In determining the appropriate weight of Māori concerns, in *Bleakley* the High Court found that Māori beliefs do have the potential to prevent an application from proceeding[137]. The Authority has a rocky history with the application of Māori beliefs, yet in their latest transgenic decision[138] appear to have moved away positions in earlier decisions considered alarming[139]. Those decisions[140] saw the EPA attempt firstly to exclude Māori spiritual beliefs from the equation[141] which the Court of Appeal in *Bleakley* refuted and later attemp to analyse and give their own interpretation of whether the claims transgenic modifications were offensive to the spiritual concerns of 'mauri' and 'whakapapa'. The Authority concluded that the definition of 'mauri' did not amount to a 'sound Māori religious objection[s] to the process of genetic modification per se'[142] and the claim of interference with 'whakapapa' was based on a "… mis-understanding of both science and traditional Māori thought"[143]. This approach was criticised for its lack of understanding of the nature of beliefs, which are not necessarily open to scientific analysis given that this is not their origins[144] and are not necessarily fixed to a particular point in time. It appears that Māori beliefs are considered to be afforded a status which removes them from an empirical analysis by virtue of their being religious and specifically identified in the legislation. Whereas another view based on individual moral beliefs unconnected with Māori is open being technically analysed. Regardless, this approach by the Authority appears to have subsided. Future decisions are instead likely to take account of the findings of the Waitangi Tribunal Report

[134] New Zealand Environmental Protection Agency *Maori Advisory Committee – Nga Kaihautu Tikanga Taiao – Terms of Reference 2011 -2014* at [4.2]
[135] Sites of spiritual significance
[136] Treasures
[137] Bleakley v Environmental Risk Management Authority [2001] 3 NZLR 213 (HC) at paras 83-87, per McGechan J. and 366 per Goddard J
[138] Application ERMA200223
[139] See Nicola R. Wheen "Belief and Environmental Decision-Making: Some Recent New Zealand Experience" (2005) 15 Journal of Environmental Law and Practice. and Mahina-a-rangi Baker "The Korowai Framework: Assessing Ge through Tribal Values" (2011) 31 New Genetics and Society.
[140] Known as the 'transgenic cattle cases'.
[141] Wheen, "Belief and Environmental Decision-Making: Some Recent New Zealand Experience."
[142] Environmental Risk Management Authority Decision, Approval Code GMD002232 on Application Code GMD02028 at 30.
[143] Ibid. at 31
[144] Wheen, "Belief and Environmental Decision-Making: Some Recent New Zealand Experience." (2005) 15 JELP

on the Wai262 claim which discussed these terms in relation to genetic modification and was especially mentioned in the latest transgenic cattle case[145], though it had not then been released.

Following *Bleakley,* there is little doubt that matters Māori, both tangible and intangible are relevant considerations as, "[t]he New Zealand Parliament has mandated... that Māori spiritual concerns be squarely addressed in [the] legislative scheme and [ERMA] cannot avoid determining metaphysical matters [it] would normally eagerly side-step"[146]. The Authority has shown reluctance in engaging with considerations of these values in the absence of scientific evidence. In fact, the legislation has been noted as being biased towards a scientific-based evaluation which doesn't leave much room for the consideration of Māori values based on beliefs which don't recommend themselves to scientific assessment. For example, clause 25(1) of the Methodology requires the Authority to 'begin with a consideration of the *scientific evidence*'[147] and clause 26 which is the main approval clause doesn't mention values at all, only 'risks' which again incorporates a measuring of risk. Also, under clauses 29 -32, which deal with situations of uncertainty, there is no specific mention of these values. While scientific uncertainty is dealt with specifically, only clause 32 would be pertinent to uncertainty in Māori values and this again requires reference to quantification via probability of those effects as a risk weighed against the 'levels given in evidence'. On the other hand, this combination of difficulty of assessment on empirical grounds and their status as a belief not open to scientific interrogation potentially gives Māori the capacity to raise any arguments connected with Māori beliefs or Treaty principles. One further potential for bias considered by the Waitangi Tribunal is the lack of weighting indicated in clause 9(c) which lists the areas that the Authority must take into account when assessing risks, costs and benefits of an application[148].

The Tribunal notes that the institutions under HSNO are strengthened by the existence of Nga Kaihautu and the compulsory inclusion of a person with Māori background on IBSC's. However they were struck by the fact that there hasn't yet been "an occasion where the views of Nga Kaihautu, or Māori cultural values generally, have prevailed in the absence of independent science-based considerations". They further doubt that the views of Nga Kaihautu will ever carry the day unless they are backed up by science and align with ERMA's science culture and don't believe the Authority has "reached the point where its systems, policies, and modes of operation achieve the standard articulated by Justice Goddard". The reference here is to the case of *Bleakley* in which Justice Goddard held that the legislation intended to "ensure that the relationship of Māori with taonga is not read down, dissipated or minimised by those charged with exercising functions,

[145] Environmental Risk Management Authority, Supporting Documents for Evaluation and Review Report on application code ERMA200223 at [3.3.35]
[146] R Adhar "Indigenous Spiritual Concerns and the Secular State: Some New Zealand Developments" (2003) 23(4) OJLS 612 at 634.
[147] Own emphasis
[148] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011)

powers and duties under the Act"[149] by the inclusion of the words 'culture and tradition' in s 6/clause 9(c)(iv).

Despite these flaws, the Tribunal records having "little doubt that the Crown is committed to taking Māori concerns seriously when it comes to the difficult topic of genetic modification"[150]. They also note the "variety of policies, strategies, and consultation documents" which the Authority has developed to "ensure that Māori perspectives are at the table when decisions about GM proposals are being made". Thus the point at which Māori have the greatest opportunity to engage in and shape an application will be in the pre-application consultation.

4.2 Consultation

The initial consultation is undertaken by the applicant, at the applicant's expense. There is no specific requirement under the HSNO Act for an applicant to consult with Māori[151] on an application or to provide the Authority with information regarding s 5 principles. However, the policy statements available on the EPA's website suggest that 'engagement'[152] with Māori by an applicant is 'appropriate'[153] and even 'required'[154] for "any application to be processed by the EPA that poses a significant impact (either positively or negatively) on outcomes of importance to Māori"[155]. The EPA's policies state that the consultation, considered to be most effective when an on-going relationship is built in during development of an application proposal, is necessary to 'gather, incorporate and address' information relevant to an application. This suggests that any application which has not been informed by 'appropriate' consultation may be considered as lacking 'sufficient information' to be accepted for consideration[156].

The EPA has identified a broad range of outcomes identified as important to Māori which 'trigger' the encouraging of an applicant to engage with the 'correct and most appropriate Māori groups'[157]. It also offers support to applicants in the form of advice from them as to their 'engagement requirement and approach' as well as providing contacts from their Māori network after determining whether the activity is one with potentially significant impacts to Māori, which Māori groups are the most appropriate and what level of consultation will be required. The level of consultation required is based on whether the application proposal will have local or national impacts of significance on Māori. The policy states that "Hazardous

[149] Bleakley v Environmental Risk Management Authority [2001] 3 NZLR 213 (HC) at [15] as per Goddard J
[150] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011)
[151] *GE Free NZ in Food and Environment Inc v Environmental Risk Management Authority* [2010?] at ***
[152] Defined in the policy (below) as, "...the range of activities undertaken prior to lodgement of applications with the EPA in order to conduct two-way interaction and communication with Maori. It is likely to include a mix of information sharing, consultation, negotiation, relationship development and management, hui/wānanga, the seeking of perspectives and the receipt of feedback."
[153] Environmental Protection Authority "Engaging with Maori for Applications to the EPA" Policy at 1
[154] See Environmental Resource Management Authority "Requirements for national consultation with Maori under the Hazardous Substances and New Organisms Act 1996"
[155] Environmental Protection Authority "Engaging with Maori for Applications to the EPA" Policy at 1 ('Principal Policy Statement')
[156] Refer discussion in [3.2.1] of paper.
[157] These being groups with the recognised mana whenua and mana moana (authority).

Substances and New Organisms Act proposals involving the release or reassessment of organisms or substances are likely to have national impacts so national engagement will be appropriate." While the EPA's Policy states that the Authority will be available to provide applications with support in monitoring engagement with Māori[158], the policy makes it clear that the applicant will bear the cost of the engagement. This may prove a significant deterrent to anyone considering an application of this nature given the level of consultation likely required by the Policy.

Under the "Requirements for National Consultation with Māori under the Hazardous Substances and New Organisms Act 1996" policy[159], applications are determined on a case by case basis as to whether national consultations with Māori will be required and at what level[160]. Generally, applications which propose the release (conditional or full) of GMO's that involve genetic material from native or valued flora or fauna will require level III consultation on a national scale. It would be highly likely that the same would be true of a development or field-test application given that policy provides a discretion for:

> ...applications of any type which raise issues of national interest for the first time or that are likely to present potentially significant risk to the biological and physical environment generally, and/or to the cultural relationship of Māori to the environment

to be required to undertake any level of consultation on a national scale. These levels range from I to III. Level I requires the distribution of written information and feedback forms followed by a communication to non-respondents. Level II requires the addition to this of the meeting and consulting with a Māori Reference group which is established and maintained by the Authority (at the expense of the application). Level III adds the invitation, organising and resourcing of meetings/discussions with iwi and Māori organisations either on a national or regional basis.

For the reasons outlined in the next section, any type of application - development, field-testing, conditional release or for full release – for the recreation of a moa or huia would I believe be precedent setting in a number of ways and ticks pretty much every box[161] in impacting areas of significance to Māori. A broad, high level consultation would be paramount in this situation, despite the cost, in order to alleviate some of the uncertainty surrounding Māori views in this area and avoid the over or understatement of views of particular parties or individuals that may unnaturally weight an inquiry and potentially hijack considerations[162]. However, a consultation may not necessarily be undertaken each time if another project is begun which the

[158] Examples given include: sharing database of Maori contact information, providing tools and information on the EPA website and maintaining a programme of hui and information exchange.
[159] This policy, while it references ERMA rather than the EPA, is one of the (*three?*) documents available under the (Te Hautu?) section of the EPA website. Assumedly this is still being applied.
[160] The levels being ranked as between I - III.
[161] See checklist of "Potential Effects on Outcomes of Significance to Maori" on EPA website, Te Hautu, < http://www.epa.govt.nz/te-hautu/info-applicants/Pages/default.aspx>
[162] See D Round "Here be Dragons" (2005) 11(1) Otago Law Review 31

Authority believes does not raise any different issues, and where notification and an on-going relationship have been established[163].

Available on the EPA website is a 'Best Practice Guideline' (commissioned by ERMA in 2010) for applicants undertaking a Tangata Whenua Effects Assessment or 'Cultural Impact Assessment' (CIA) which is a "process for identifying the effects of an application on tangata whenua and their culture and values to inform [the Authority] in making its decision in accordance with the legislation." The guideline notes that, like consultation, there "is no statutory obligation to produce such an assessment, however where there is any potential for impact on tangata whenua, their environment, culture and values, a CIA is best practice." Consultation via the establishment of an on-going relationship is again suggested as the most appropriate way to gather information for this assessment[164].

An application to de-extinct a native species would have major precedent value in terms of consultation, and be a serious test of the EPA's consideration and weighting of Māori concerns[165]. In the latest decision of the Authority in the series of AgResearch applications, ERMA200223, the Committee's Evaluation and Review Report considered a number of effects in relation to the Treaty of Waitangi, Māori and their relationships with the environment, culture, health and well-being, and economic development. However for almost every effect identified, the fact that the application was for a containment approval was relied upon to negate the necessity to engage with many of the potential effects and ultimately for others to be negligible given the probability of escape[166].

No application for release of a genetically modified organism has yet been made, nor a containment application for a new organism incorporating genetic material from an indigenous species (at least since the release of the Waitangi Tribunal report on the Wai262 claim). Thus an application of the sort being discussed here would force the EPA into waters which previously it has merely dipped its toes.

4.3 Potentially Significant Effects to Māori Relationships

The EPA is tasked with first identifying all potential effects then determining which are significant and assessing those based on a weighing up of their relative likelihoods and magnitude of effects. Due to the restricted nature of this inquiry, I will attempt to identify and address the potentially *significant* effects which are likely to arise in an application to de-extinct native species. I will group these under the areas suggested by the EPA's Engaging with Māori Policy[167], being the effects on;

[163] Evaluation and Review Report on application ERMA200223 at [3.3], despite protests from Maori it was not considered necessary for AgResearch to undertake a consultation for this latest application given the extensive nature of the consultation conducted for earlier, similar applications and the notification of all those who had taken part as well as discussing the latest proposal with the local iwi. Further, a control of an iwi/Maori established an iwi/Maori monitoring group.
[164] Other opportunities arise at the public notification and submission stages however these would likely have less impact.
[165] Go back and defined 'concerns' as your term for 'values, beliefs etc' early on.
[166] Evaluation and Review Report on application ERMA200223 at [2] p 30.
[167] See Appendix of Environmental Protection Authority "Engaging with Maori for Applications to the EPA"

1. Environment – including productivity and life-sustaining quantity and quality of the natural resources and flora and fauna valued by Māori;
2. Culture – including the effect of the kaitiakitanga role of Māori in the protection and enhancement of mauri, mana and tapu of various (things);
3. Social, Health and Wellbeing – including the individual aspects such as mental, spiritual and physical health which constitute the holistic nature of hauora;
4. Economic development – including preservation of on-going capacity and capability of Māori to be economically sustainable and provide for participation in the generation of economic benefits;
5. Giving effect to the principles of the Treaty of Waitangi

4.3.1 Environment

The issues for Māori under this heading, being of a more practical nature are likely to be considered along the same lines as issues discussed under the environmental effects heading of the previous section. However, the inquiry here will be specific to the relationship of the Māori community to the environment. For example, whether there is a threat to traditional Māori food resources and other natural resources, including flora and fauna which are indigenous or valued by Māori.

For containment applications it is likely that this inquiry would be couched in terms of the likelihood of 'escape' and horizontal gene transfer, to qualify risk as this reduces the presence of risk characteristics[168]. A key consultation point for AgResearch and local iwi in the decisions on which the *Bleakley* case was brought, was the site of the projects themselves, and the methods and site for disposal of genetic material. Other considerations which were determined to be negligible given containment included: the leaching of genetic material or by-products into waterways; effects on native flora and fauna; and GM contamination of Māori-based organic products.

Escalation of concerns is certain in the case of application for release – increased concern over protection of other indigenous and valued flora and fauna and whether the GMO's might enter the food chain or 'contaminate' the mauri of other sites or animals in various ways.

Depending on how a de-extinct bird is viewed, the de-extinction of native species could be considered an opportunity to advance Māori's relationship with their environment – developing the technology which would allow them to not only better conserve but to augment and restore their environment to an ancestral state. It may also provide an opportunity for Māori to learn more about the application of their own culture in the modern world and the make-up of their flora and fauna heritage.

[168] Methodology, cl 33

4.3.2 Culture

In identifying and weighing adverse and beneficial effects on the maintenance and enhancement of Māori capacity for 'cultural well-being' as required under s 5(b) of the HSNO Act, the key term for consideration is 'kaitiakitanga'. The essence of kaitiakitanga is the inherited responsibility of Māori from their tupuna[169] within their atua[170] in accordance with tikanga Māori[171]. A fundamental responsibility of this guardianship is the maintenance and enhancement of 'mauri', that is, physical and spiritual well-being of the environment, including that of 'taonga' species. The existence of a kaitiaki relationship between iwi, hapū or whanau and a species of flora or fauna is what makes the species 'taonga'[172]. Evidence of mataraunga Māori – the tribe's traditional knowledge of the species in "whakapapa, waiata and other performance arts, and in korero or story" to verify authenticity of the kaitiaki relationship. [173]

Comments made by the Waitangi Tribunal in their report on the Wai262 ('Tribunal's Report') claim indicate that the definition of species as taonga may become a crucial aspect of future decision making by the EPA, if Māori with established kaitiaki relationships are recognised as having greater rights of directing the use of their taonga species. The Tribunal's findings support the adoption of the term 'kaitiakitanga' into the HSNO legislation in s 5, requiring the recognition and provision for the relationship between kaitiaki and their taonga species[174]. Before the Tribunal Reports' release, the term's use was already increasing[175]. Both the Marine and Coastal Area (Takutai Moana) Act 2011 and the Resource Management Act 1991 reference kaitiakitanga[176], with the Takutai Moana Act specifying that Māori groups exercising kaitiakitanga in an area where conservation processes are taking place have a right to *participate* in that process. In 2005 a requirement was added to the Resource Management Act 1995 to keep records of regions over which iwi or hapū exercise kaitiakitanga[177]. A similar register is suggested by the Waitangi Tribunal in regards to genetic resources. While no amendments have yet been made to the HSNO Act, the Authority are already considering 'depletion of the ability of Māori to perform their role as kaitiakitanga' a key adverse effect in their decision-making process[178].

The latest AgResearch decision references the Tribunal's Report prior to its release, indicating that future considerations of applications' effects on Māori relationships will involve an inquiry framed around 'complex

[169] Ancestry
[170] Tribal territory
[171] Rules or customs, relating to 'doing things the right way'
[172] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) [2.2.2.] at 65
[173] Ibid.
[174] Ibid. p96 at [2.8]
[175] Examples can be found at http://www.teara.govt.nz/en/kaitiakitanga-guardianship-and-conservation
[176] Resource Management Act 1995, s 7 and ss47, 49 and 85 of the Marine and Coastal Area (Takutai Moana) Act 2011 (successor to the Foreshore and Seabed Act 2004).
[177] Resource Management Act 1995,s 35A
[178] See Evaluation and Review Report and Decision Document on Application ERMA200223

and varied'[179] kaitiaki relationships. Māori have kaitiaki relationships with many aspects of their environment, including land, waterways and ecosystems. In this decision, concerns were noted about the effect on the mauri of each of these and that of other native flora and fauna via contamination from genetic modification. The Authority identified the potential methods of exposure as through: the waste and disposal of GM animals; the escape of GM animals; and horizontal gene transfer. Each of these was considered not likely to be significant.

The Authority determined that the effect on the mauri of these aspects was negligible given the lack of information available, including that monitoring had not yet identified any specific effect to mauri from groundwater contamination or general effect from the keeping of GM animals in containment. The Authority admitted uncertainty around the potential effects to mauri, and the difficulties in observing and measuring intangible effects. However, the measure used to determine that there had not been an adverse effect on mātauranga and tikanga Māori was the fact that these beliefs, "continue to exist and be actively referenced by the community"[180]. This to me does not seem an adequate measure. The Authority did address this uncertainty in other ways by the inclusion of a control requiring the appointment of an iwi monitoring group for on-going monitoring, discussion and addressing of adverse intangible effects and cultural issues.

a) Application to Hypothetical De-Extinctions

Given the likely consideration of the Tribunal's Report, the first step in this paper's inquiry is to determine if the species in the de-extinction scenarios are 'taonga'. For an application this may be established at the consultation stage or from the proposed register. The second step is the identification of the impact which granting the application may have on that kaitiaki's role, and the likelihood and magnitude of those effects. For example, uses ranging from the extraction, duplication and sequencing of a taonga species' DNA is considered by some to infringe on this relationship, but not to the same degree as attempting to derive a live animal from that DNA. Finally, whether mitigation via on-going consultation and controls are enough to reduce adverse effects to a negligible level or to the point where they can be outweighed by identified benefits.

Applying this framework to the species identified in the scenarios – kakapo, huia and moa – identifies some of the challenges and concerns that would be raised.

i) Is there a kaitiaki relationship which makes the species 'taonga'?

The Tribunal's Report states that, "[f]or kaitiaki, there can be no relationship with taonga if the taonga no longer exist; nor, without the taonga, can the mātauranga survive"[181]. Thus the question is raised whether kaitiakitanga continues in a species' genetic resources when extinct. If not, there is less

[179] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) [2.2.2] at 65
[180] Decision Document on ERMA200223 27 at [6.2.32]
[181] Waitangi Tribunal *Ko Aotearoa Tēnei:* Taumata Tuarua (Legislation Direct 2011) Vol 1 [4.5.8] p340

potential for interference with whakapapa and mauri. While arguable, given the strong spiritual connection whakapapa invokes and the histories and ancestries which define Māori relationships generally, I don't feel that the fact of extinction of a species is necessarily a barrier to the continuation of kaitiakitanga for the purposes of considering the use of their genetic material. For example, 'waahi tapu', or sacred ground, is included in s 6 of the HSNO Act recognising the spiritual connection with the dead. Also, the whakapapa (geneaology) of a species would be in a sense revived by de-extinction, thus reviving concern in the preservation of that lineage. However, it would be an important question to be raised in consultation. The Tribunal's statement was made in the context of supporting conservation as the paramount objective over other considerations, including kaitiaki, yet it does not necessarily translate to a statement that all iwi consider this relationship to cease to exist with a species' physical existence, and earlier the in the Report, the Tribunal specifically discusses relationships with 'biological resources'[182].

In establishing the existence of kaitiakitanga of a species there is a risk of deconstructing the 'holistic and complex' relationship too far[183], and this determination may be a unsavoury role for the EPA given their naturally reductionist approach evident in past decisions[184]. However, the Tribunal has noted that this relationship should be identified from evidence in mātauranga Māori. This is still a challenge as "in some cases there will be multiple kaitiaki [with] a genuine interest", due to the different mātauranga communities have developed about a species[185]. The Tribunal suggests that the proposed register record "the relevant kaitiaki in the first instance"[186] as being the particular iwi or hapū whose rohe[187] is the origin of genetic material in question. This may prove problematic where the specimen used is from a museum or private collection.

The birds:

- **Kakapo**: There is every reason to believe that numerous kaitiaki relationships could be established for the kakapo, especially tribes such as Ngāti Kuia and Ngāi Tahu who have had a role in their conservation[188] and who have recognised kaitiaki in the regions where kakapo originated and have been subject to conservation management programmes[189].

[182] For example in Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) [2.6.4] p94 and [2.4.3(7)] on pg 84
[183] Waitangi Tribunal *Ko Aotearoa Tēnei:* Taumata Tuarua (Legislation Direct 2011) Vol 1 [2.2.1] p117
[184] See Baker, "The Korowai Framework: Assessing Ge through Tribal Values." and Wheen, "Belief and Environmental Decision-Making: Some Recent New Zealand Experience."
[185] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) [2.6.4] p94
[186] Ibid. [2.6.4] p94
[187] Territory.
[188] For example see Department of Conservation "Last 5 Kakapo in Sounds going to Fiordland" (Scoop Independent News 23 May 2003) <http://www.scoop.co.nz/stories/PO0305/S00214/last-five-kakapo-in-sounds-going-to-fiordland.htm>
[189] Waitangi Tribunal *Ko Aotearoa Tēnei:* Taumata Tuarua (Legislation Direct 2011) Vol 1 at 326 [4.5.1(2)]

- **Huia**: Despite their extinction the huia arguably have one of the strongest evidentiary resumes for a kaitiaki relationship with North Island hapū Ngāti huia. Not only is their ancestry believed to be derived from the huia, there are numerous verbal and recorded histories, including European records of their practicing traditional rahui[190] in attempting to prevent the species' extinction[191]. This relationship is also recognised in modern New Zealand histories. For example the Te Ara encyclopaedia of New Zealand states that:

  > the people of the Ngāti Huia tribe saw the extinction of the huia as calamitous. The bird was central to their identity and mana (status)[192].

  Their kaitiaki claim has in fact been recognised in relation to use of huia specimens as a genetic resource for the sequencing and cloning of DNA. When research was undertaken in 1999 to extract and clone huia DNA, a hui was sought and held with the hapū seeking their consent for the project.

- **Moa**: The clearest way to establish kaitiaki for the moa would be to adopt the Tribunal's suggestion of identifying the rohe from which the remains were sourced. However this may be an issue where that rohe cannot be identified and provides a potentially arbitrary bias in the weighting of views in consultation. From a mātauranga Māori perspective, there is clear evidence of utilisation as a food source, however the more spiritual connection would require the production of evidence through consultation.

ii) Would this use have adverse effects which would deplete the ability of Māori to perform their kaitiaki role?

The continuing, base concern of Māori is that genetic modification interferes with the whakapapa and mauri of species. The Authority notes that this concern exists, "regardless of the scale and nature of any research proposed and does not necessarily alter with the imposition of containment measures"[193]. However, I think it likely that this concern would increase according to the use of a species' DNA. In the past, concerns were raised over the extraction and sequencing of DNA, therefore the use of that DNA in on-going experimentation and potential hybridisation[194] would likely be alarming to many Māori despite the proposed final outcome. The kakapo cloning scenario may be the least contentious given that the source genetic material will remain intact and the strong

[190] The setting of restrictions on activities, in this case the hunting of the huia, which is a traditional practice as part of kaitiaki. See Te Ahukaramū Charles Royal 'Kaitiakitanga – guardianship and conservation - Traditional kaitiakitanga', Te Ara - the Encyclopedia of New Zealand, 2012 <http://www.TeAra.govt.nz/en/kaitiakitanga-guardianship-and-conservation/page-3>
[191] James Drummond "The Huia Bird" *The Spectator* (Online Archive, originally published 14 May 1910) at 16 <http://archive.spectator.co.uk/article/14th-may-1910/16/the-hula-bird >
[192] Rāwiri Taonui. 'Whakapapa – genealogy - What is whakapapa?', Te Ara - the Encyclopedia of New Zealand, updated 1-Jul-13 <http://www.TeAra.govt.nz/en/whakapapa-genealogy/page-1>
[193] Decision Document on application ERMA200223 at 27 [6.2.32].
[194] Compromising the mauri of multiple species.

emphasis on conservation of modern species[195]. However, the incorporation of germs cell into chicken embryos may still be seen as contrary to tikanga Māori, thus consultation is necessary to establish the range of views and concerns on any particular use[196].

Interestingly, at the 1999 hui where discussion of cloning the huia took place, Ngāti huia gave their consent in principle for the attempted cloning of the bird[197]. This could not be taken as the view of all Māori, and details aren't available as to what technology was proposed, but this indicates that there is very real interest in reviving lost species, even at the apparent cost of the manipulation of their genetic identity.

In regards to containment, the evaluation by the Authority will likely follow the same lines as previous containment applications, with an emphasis on the reduced probability of effect given the controlled environment, containment standards and lack of evidence of previous effects on the environment or Māori relationships.

iii) Could these effects be mitigated by controls or consultation?

As previously stated, consultation would be required to establish a range of views before potentially mitigating controls could be suggested. Previously, relationships with iwi have been mandated and built which directed the details of projects such as the disposal of genetically modified material. A relationship of not only consultation but active involvement in a project is perhaps the most prudent suggestion at this stage given the uncertainty abounding not only as to effect but also of Māori views on this subject. What 'active involvement' would entail, in attempting to balance the interests of both kaitiaki and researchers is a complex question requiring much more attention than can be given here.

b) Broader Cultural Benefits

Benefits which rely on the views of Māori are only speculation, but the following might be considered by the Authority as potential benefits to Māori relationships relevant to an application:

- Opportunity for particular iwi and applicants to work "collaboratively and proactively in the investigation of cultural and other effects resulting from genetic modification", which in regards to a containment application could take place in a "safe and manageable situation"[198];

[195] The Waitangi Tribunal in their Wai 262 report put conservation considerations firmly ahead of Maori interests – see Taumata Tuarua (Vol 1), Chapter 4
[196] Supported by approach to uncertainty in clause 32 of Methodology.
[197] Unknown author, "Cloning the Huia – A Dodo of an idea?" (Scoop Independent News 13 July 1999) <http://www.scoop.co.nz/stories/SC9907/S00005.htm>
[198] Decision Document on Application ERMA200233 (decision doc) at 28

- Research of this kind may further empower kaitiaki with knowledge and information that could enhance their role in the future;
- Restoration of a kaitiaki relationship;
- Opportunity for kaitiakitanga to become a driving force behind the reinstatement of extinct species, developing a unique combination of conservation and development. This may bring Māori culture to greater national and global recognition at the forefront of biodiversity and conservation.
- Use of this technology to restore other aspects of their environment, or as a tool for the provision of redress by the Crown for the loss of particular species of flora or fauna.

This area contains many complex and varied concerns which centre around the developing use of the term 'kaitaikitanga' and its likely implementation into EPA decisions, if not the HSNO legislation.

4.3.3 Social, Health and Well-Being

The EPA engagement guidelines suggest the statutory obligation under s 5(b) of the HSNO Act to 'recognise and provide for ... social... well-being' and the s6 consideration of public health by incorporates elements which, "express the holistic nature of hauora (Māori health and wellbeing)"[199]. The effects considered relevant to the s 5(b) principle will be relative to the views of Māori regarding de-extinct species. For example, on the one hand it may be considered that the restoration of a taonga species would support the taha wairua[200], taha whanaunga[201] and taha hinengaro[202] by enabling Māori to reconnect and resolve past grief such as the loss of the huia, and further provide them with a tool for achieving a new balance with the environment. On the other hand, the base destruction of mauri by the genetic engineering of these species may mean that this is considered a highly offensive proposition which would further undermine tikanga Māori and cause further grief to Māori by frustrating their ability to "impact upon proposed research". A further concern in relation to release applications may be the entering of the genetically modified material into the food chain resulting in Māori eating spiritually offensive products.

The EPA is unlikely to consider that these effects have an appreciable risk (i.e. significant magnitude and probability) unless evidence is provided of an effect on taha tinana[203], being a more observable measure. They may also consider that, in the case of uncertainty, effective and on-going monitoring or consultation would reduce the potential impact of these issues to an acceptable level.

[199] Environmental Protection Authority "Engaging with Maori for Applications to the EPA" Appendix 1
[200] Spiritual health and well-being obtained through the maintenance of a balance with nature and the protection of mauri.
[201] The responsibility and capacity to belong, care for and share in the collective, including relationships and social cohesion.
[202] Mental health and well-being and the capacity to communicate, think and feel.
[203] Physical health and well-being.

4.3.4 Economic Development

The principle in s5(b) has been interpreted as relating to 'Māori' in place of 'people', requiring the EPA to "recognise and provide for the maintenance and enhancement of the capacity of [Māori] to provide for their own economic … wellbeing" and those that are reasonably foreseeable for future generations.

Claims for recognition of proprietary rights in taonga species was refuted by the Waitangi Tribunal's Report[204], therefore it is unlikely that Māori will be able to claim loss of economic benefit from the rights which be attributed by law to the developers of de-extinct species – though this could be challenged on moral grounds[205].

GM contamination of Māori-based organic crops is another potential concern for Māori economic capacity. However the EPA is likely to respond with the same considerations as for organic farmers, with an emphasis on the lack of evidence for horizontal gene transfer and the controlled environment in which the animals will be kept. In regards to a release application, this concern may be attributed greater probability, although by then more evidence in regards to horizontal gene transfer should be available.

Beneficial effects under this heading would likely depend upon the purpose of the project and whether a joint venture is undertaken either at the outset or as part of the engagement process.

4.4 Treaty of Waitangi/ Te Tiriti o Waitangi

Under s 8 of the HSNO Act, the EPA is required to 'take into account' the principles of the Treaty of Waitangi. This requires evaluation of the impact approving an application would have on the following four potentially relevant[206] Treaty principles;

1. The obligation to act reasonably, in utmost good faith and in a manner that is consistent with partnership;
2. The requirement for all decision to be made from an informed basis;
3. The obligation to actively protect Māori interests; and
4. The obligation on the Crown to not unduly impede or diminish its capacity to provide redress where a valid Treaty grievance is established.

The first of these is continually being addressed by the development of protocols and processes which not only notify Māori of outcomes that may affect them, but allow them the opportunity to engage in those

[204] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) Chapter 2, p64.
[205] For example, cl 15 the Patents Act 2013 appears to directly exclude the patenting of the process of de-extinction and the resulting animal, being contrary to morality or the public order.
[206] These principles were *New Zealand Maori Council v Attorney General* [1987] 1 NZLR 641 and referred to in past ERMA decisions.

processes[207]. Approval of an application to de-extinct a native species will not in itself breach this principle unless the processes which the EPA follows and requires of the applicant – consultation, consideration and controls – are not done in a 'transparent' manner which recognises the identified areas of taha Māori under the HSNO Act. Similarly, the second principle is often not directly addressed in application decisions, but it strengthens the requirement for consultation. The Authority arguably have used consultation as a patch for the consideration of issues in the past, having stated in their last decision that "[c]onsultation with Māori is a means of giving effect to sections 6(d) and 8"[208]. While important, consultation is not considered a real mitigating factor by Māori with regard to important effects.

The third principle – and to some extent the fourth - have been the subject of the most controversy and analysis by the Courts, commentators and the Authority in regards to HSNO Act applications. The provision of redress is not a role that is envisaged for the Authority under HSNO, instead the consideration is whether the approval of an application would 'unduly impede or diminish' the Crown's capacity to provide redress. In order for this to be argued, a direct link between a genuine claim by Māori for redress of a breach by the Crown and the approval of the application would need to be shown. For example, one of the claims made in the Wai262 claim was for recognition of Māori having a proprietary interest in the genetic resources of native New Zealand species, or at least 'taonga' species[209]. On this basis, the approval of an application for de-extinction could provide commercial exploitation rights to the developer contrary to the proprietary rights of Māori in those genetic resources, and once those rights to commercial development are gained the redress to Māori would be impaired. However, as the Tribunal has emphatically shut the door on proprietary interests for Māori in these species and their genetic or biological resources, the remaining avenue here may be through an alleged breach of kaitiakitanga.

In *Bleakley* it was determined that the principle of active protection extended to intangible (or spiritual) beliefs which, "may, in some cases, require decisions to be made according to tenets of Māori spiritual belief." [210] That significance is dependent on "all the circumstances and issues arsing."[211] However, these beliefs will still be weighed in accordance with the Methodology, and as such can be outweighed by benefits.

The interests which will likely require particular attention in reference to this principle are: mātauranga and tikanga Māori; kaitiakitanga; and the ability of Māori to develop their resources economically.[212] All three of these interests have relevance to an application to de-extinct a species under HSNO but cannot be fully developed within the scope of this paper.

[207] For example, the EPA guidelines which create a policy requiring engagement of Maori where outcomes of importance to them are identified.
[208] Decision Document on application ERMA200223 [6.2.24] p26
[209] Waitangi Tribunal *Ko Aotearoa Tēnei:* Taumata Tuarua (Legislation Direct 2011) Vol 1
[210] *Bleakley v Environmental Risk Management Authority* [2001] 3 NZLR 213 (HC) as per Goddard J at [28]
[211] Ibid.
[212] Discussed at [4.3.4]

One further right which was noted in the ERMA200223 decision is the Treaty of Waitangi right to choose to remain free from GM contamination/pollution. An argument which could be developed in the future may use this based on either health and well-being or the ability to make that choice being a key component of tino rangatiratanga.

Conclusion

The HSNO Act's stated purpose is the prevention or management of adverse effects of hazardous substances and new organisms in order to protect the environment, and the health and safety of people and communities[213]. The legislation is geared towards the containment and control of risks. This is at odds with the long-term goals of de-extinction in restoring extinct flora and fauna to New Zealand ecosystems. The legislation does not fully accommodate the conservation element of de-extinction, but it can be adapted given the scope of the EPA to consider wider views and the principle of ecosystem enhancement in s 5(a). The current policies and procedures adequately gather views of Māori and the New Zealand public to begin the necessary discourse to determine the underlying social response to the challenges that de-extinction poses.

An application to de-extinct a native species would establish a number of precedents. As yet, no application has been made for the release of a genetically modified organism in New Zealand, leaving barriers from uncertainty and strong views on genetic modification. However, given the EPA's approach to risk in relation to containment applications, a developer who has undertaken broad Māori consultation, and applies to use established techniques to develop a de-extinct species in containment has a good chance of success. The uncertainty of release from containment has the potential to create a hiatus for projects undertaken to de-extinct species which may be a disincentive for developers who would need to outlay a significant amount of money in undertaking pre-application consultation and gathering of information before even beginning development.

Ultimately the Authority's decision at this stage will come down to whether 'sufficient information' can be acquired to effectively judge associated risks, and potentially the social judgement as to whether de-extinct species ought to be considered 'native species', enhancing New Zealand's image and Māori kaitiaki relationships, or genetically modified abominations undermining mauri and whakapapa, and which pose intolerable risks to true native species, environment and New Zealand's international markets.

It is my view that the New Zealanders generally should be invited to consider the opportunities that de-extinction offers in the context of its potential application to conservation. Whether de-extinction can begin

[213]Hazardous Substances and New Organisms Act 1996, s 4

to change perceptions of genetic modification or be considered a worthy exception underpins many of the social effects which the EPA considers for an application.

And I will leave you with this thought: [214]

> …there is a bigger picture as well. The technology we have discussed in this chapter reflects the fact that humans have come to exercise control over the matrix of life itself. We now have powers that were once the exclusive preserve of the gods. These developments must be matched by our moral and ethical capacity to make good decisions in deploying these technologies for ourselves and future generations. By introduction the ethic of kaitiakitanga into these processes, we enrich our moral and ethical capacity, and we will make better decisions. If kaitiakitanga says we humans are less important and that taonga species and the whakapapa of life are more important, then that outcome alone will benefit all of us.

[214] Waitangi Tribunal *Ko Aotearoa Tēnei: Te Taumata Tuatahi: a Report Into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity* (Legislation Direct, 2011) p95

Bibliography

Allentoft, Morten E, Matthew Collins, David Harker, James Haile, Charlotte L Oskam, Marie L Hale, Paula F Campos*, et al.* "The Half-Life of DNA in Bone: Measuring Decay Kinetics in 158 Dated Fossils." *Proceedings of the Royal Society B: Biological Sciences* 279, no. 1748 (2012): 4724-33.

Baker, Mahina-a-rangi. "The Korowai Framework: Assessing Ge through Tribal Values." *New Genetics and Society* 31, no. 1 (2012/03/01 2011): 87-98.

Barnes, Julie-Anne. "After Dolly the Sheep... Duck Is Dad to a Chicken [Scot Region]." *Daily Mail*, 2013 Mar 18 2013, 36.

Boland, Michael J., Jennifer L. Hazen, Kristopher L. Nazor, Alberto R. Rodriguez, Wesley Gifford, Greg Martin, Sergey Kupriyanov, and Kristin K. Baldwin. "Adult Mice Generated from Induced Pluripotent Stem Cells." [In English]. *Nature* 461, no. 7260 (2009 Sep 03 2009): 91-4.

Campbell, K. H. S., J. McWhir, W. A. Ritchie, and I. Wilmut. "Sheep Cloned by Nuclear Transfer from a Cultured Cell Line." *Nature* 380, no. 6569 (03/07/print 1996): 64-66.

Cooper, Roger A., and Philip R. Millener. "The New Zealand Biota: Historical Background and New Research." *Trends in Ecology & Evolution* 8, no. 12 (12// 1993): 429-33.

Daugherty, Charles H., George W. Gibbs, and R. A. Hitchmough. "Mega-Island or Micro-Continent? New Zealand and Its Fauna." *Trends in Ecology & Evolution* 8, no. 12 (12// 1993): 437-42.

Duncan, Richard P., and Tim M. Blackburn. "Extinction and Endemism in the New Zealand Avifauna." *Global Ecology and Biogeography* 13, no. 6 (2004): 509-17.

Environment, Ministry for the. "The New Zealand Biodiversity Strategy." edited by Department of Conservation. Wellington, 2000.

Folch, J., M. J. Cocero, P. Chesné, J. L. Alabart, V. Domínguez, Y. Cognié, A. Roche*, et al.* "First Birth of an Animal from an Extinct Subspecies (Capra Pyrenaica Pyrenaica) by Cloning." *Theriogenology* 71, no. 6 (4/1/ 2009): 1026-34.

Hayashi, Katsuhiko, Sugako Ogushi, Kazuki Kurimoto, So Shimamoto, Hiroshi Ohta, and Mitinori Saitou. "Offspring from Oocytes Derived from in Vitro Primordial Germ Cell–Like Cells in Mice." *Science* 338, no. 6109 (November 16, 2012 2012): 971-75.

Kiefer, J. C. "Epigenetics in Development." [In eng]. *Dev Dyn* 236, no. 4 (Apr 2007): 1144-56.

Liu, Chunhai, Jörg Kinne, Vijay Baskar, Zhor Guerineche, Ulrich Wernery, and Il-Kuk Chang. "Houbara Bustard Hatching in Surrogate Chicken Albumen and Eggshell." [In English]. *Avian Biology Research* 6, no. 3 (Aug 2013 2013): 239.

Logan, Hugh. "Gondwana Invaded: An Address on Distinctive Features of Managing Indigenous Biodiversity in Protected Areas in New Zealand." *Journal of the Royal Society of New Zealand* 31, no. 4 (2001): 813-18.

Macdonald, J., L. Taylor, A. Sherman, K. Kawakami, Y. Takahashi, H. M. Sang, and M. J. McGrew. "Efficient Genetic Modification and Germ-Line Transmission of Primordial Germ Cells Using Piggybac and Tol2 Transposons." *Proceedings of the National Academy of Sciences of the United States of America* 109, no. 23 (06/ 2012): E1466-72.

Matthews, Kara J., Maria Seton, and R. Dietmar Müller. "A Global-Scale Plate Reorganization Event at 105–100 Ma." *Earth and Planetary Science Letters* 355–356, no. 0 (11/15/ 2012): 283-98.

Miller, Webb, Daniela I. Drautz, Aakrosh Ratan, Barbara Pusey, Ji Qi, Arthur M. Lesk, Lynn P. Tomsho*, et al.* "Sequencing the Nuclear Genome of the Extinct Woolly Mammoth." *Nature* 456, no. 7220 (11/20/print 2008): 387-90.

Newton, Ian. *Population Limitation in Birds*. Population Limitation in Birds. London: Academic Press, 1998. doi:http://dx.doi.org/10.1016/B978-012517365-0/50016-8.

Oh, HJ, M. K. Kim, G. Jang, H. J. Kim, S. G. Hong, J. E. Park, K. Park*, et al.* "Cloning Endangered Gray Wolves (Canis Lupus) from Somatic Cells Collected Postmortem." *Theriogenology* 70, no. 4 (9/1/ 2008): 638-47.

Ohta, Hiroshi, Yuko Sakaide, and Teruhiko Wakayama. "The Birth of Mice from Testicular Spermatozoa Retrieved from Frozen Testicular Sections." *Biology of Reproduction* 78, no. 5 (2008): 807-11.

Vogel, Gretchen. "Cloned Gaur a Short-Lived Success." *Science* 291, no. 5503 (2001): 409.

Wheen, Nicola R. "Belief and Environmental Decision-Making: Some Recent New Zealand Experience." [In English]. *Journal of Environmental Law and Practice* 15, no. 3 (Jun 2005 2005): 297-317.
Yao, Lin, Xiya Yu, Ning Hui, and Shanrong Liu. "Application of Ips in Assisted Reproductive Technology: Sperm from Somatic Cells?" [In English]. *Stem Cell Reviews* 7, no. 3 (Sep 2011 2011): 714-21.